TECHNOLOGY REVIEW

December 1949

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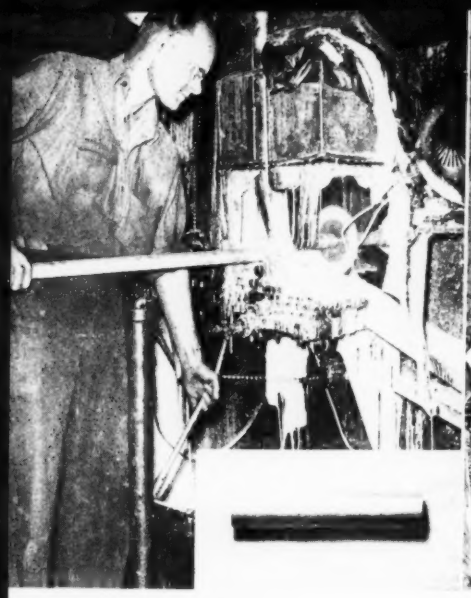

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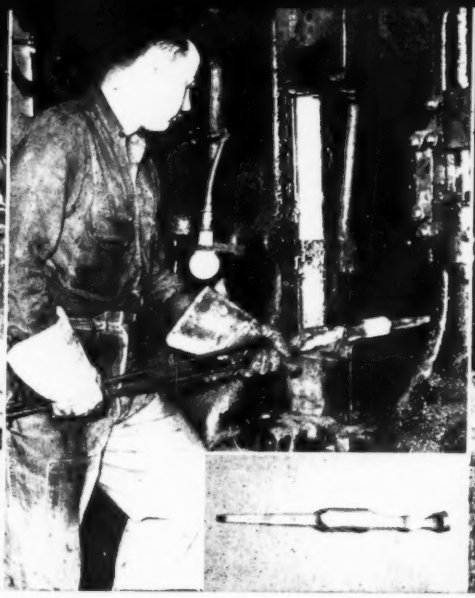

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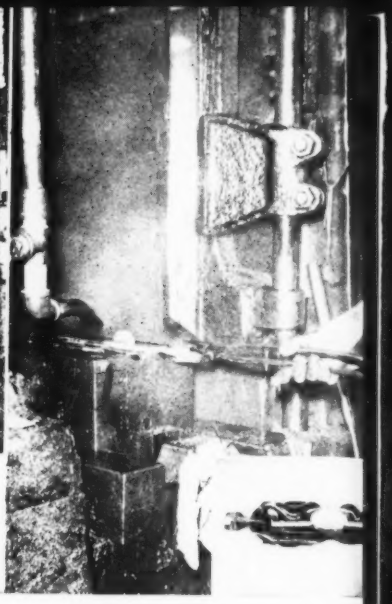
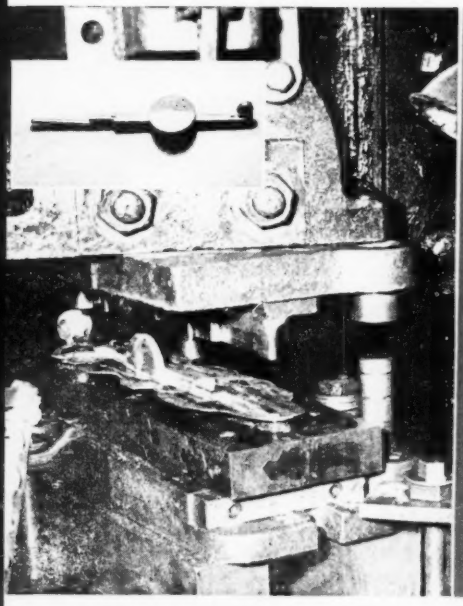


Shaping to the Die



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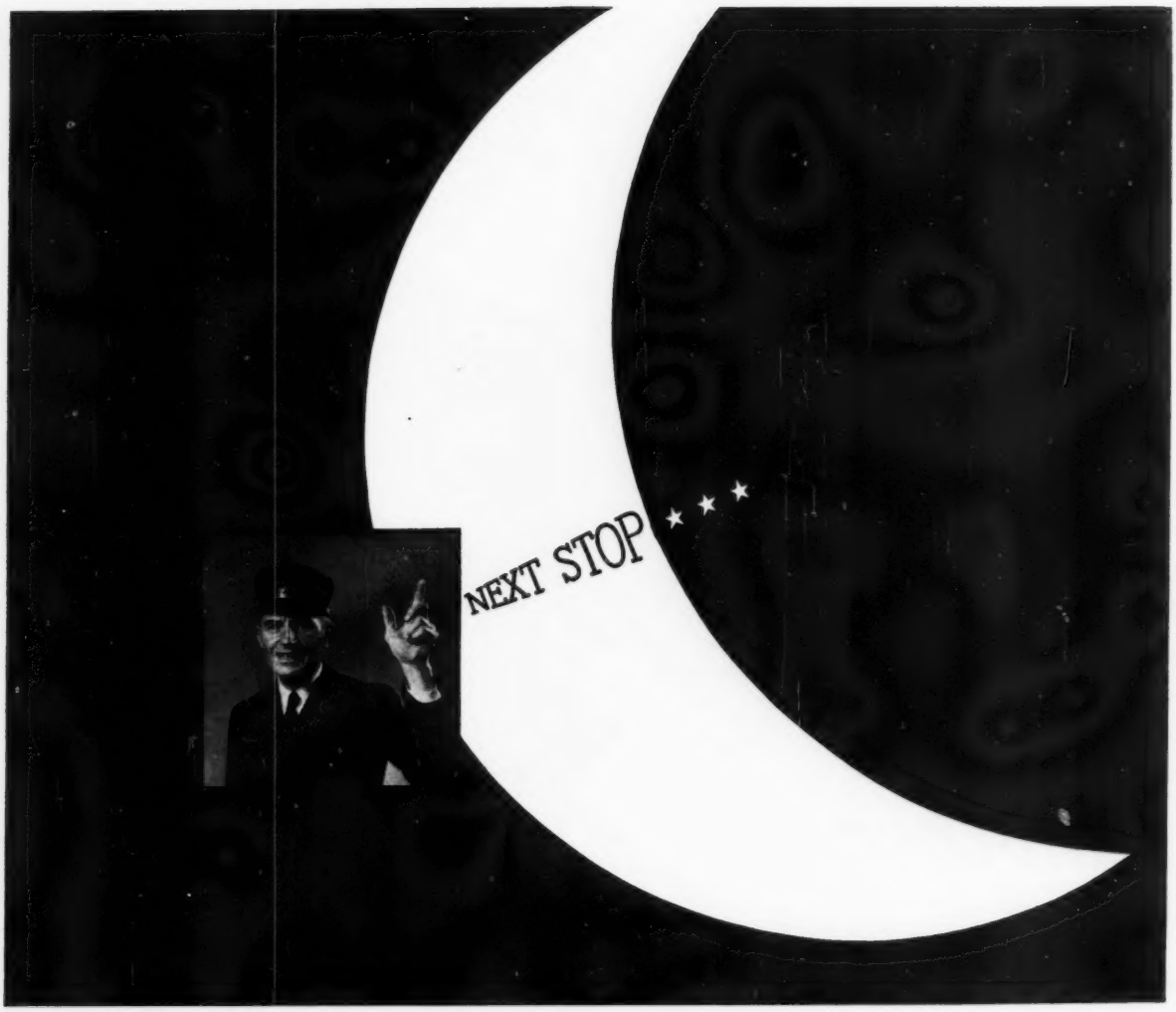

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Much work remains to be done — nothing comparable to another Oak Ridge, however — but intelligent people are working seriously on problems of space ships and means for travel in atmospheres like the moon.

National Research has, for some time, been concerned with problems relating to space travel — problems not too far removed from many encountered in the high vacuum field. To name a few: altimeters for use above 200,000 feet, speedometers for use beyond the sonic range, gas-free metals for rockets, analysis of components of the upper atmosphere, and simulation of upper atmosphere conditions in the laboratory.

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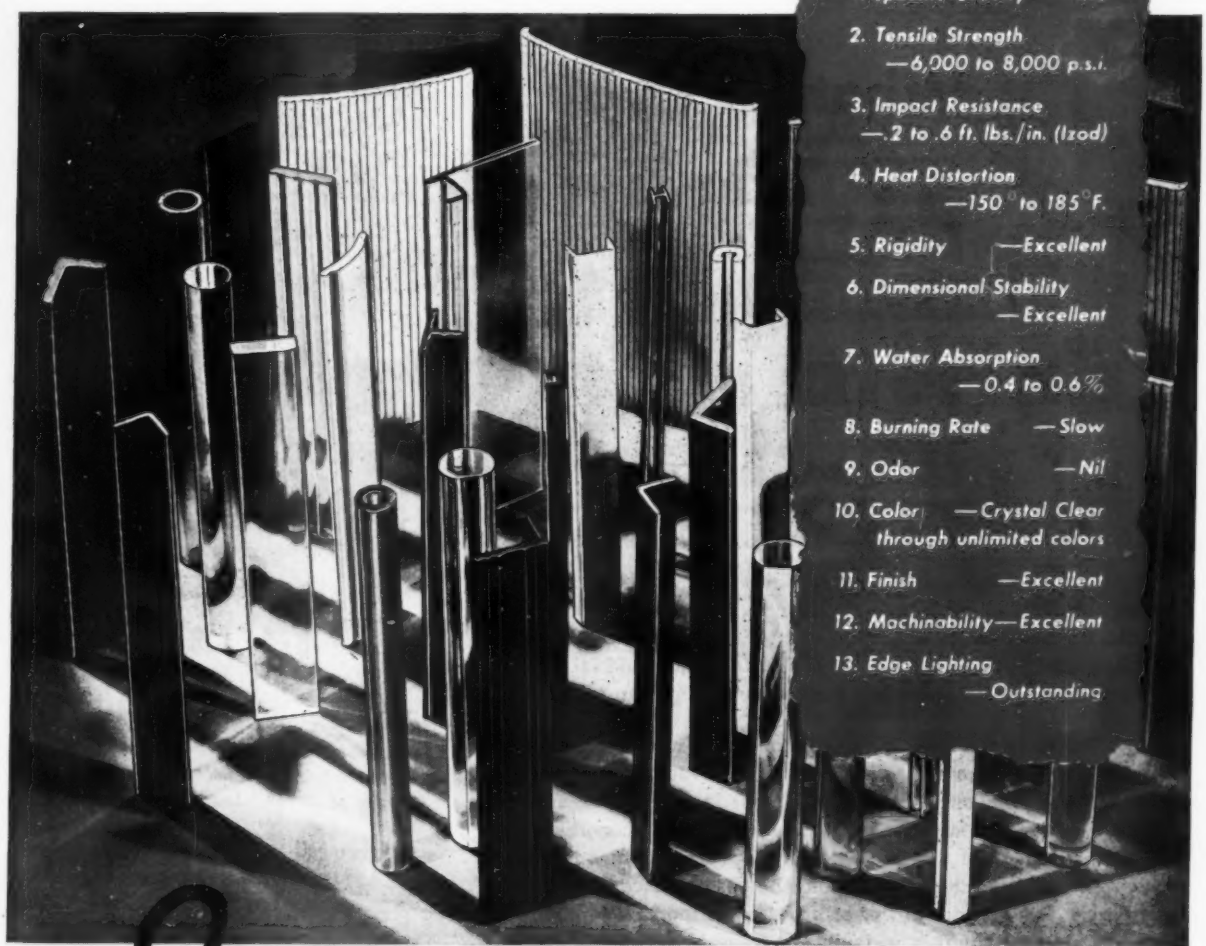

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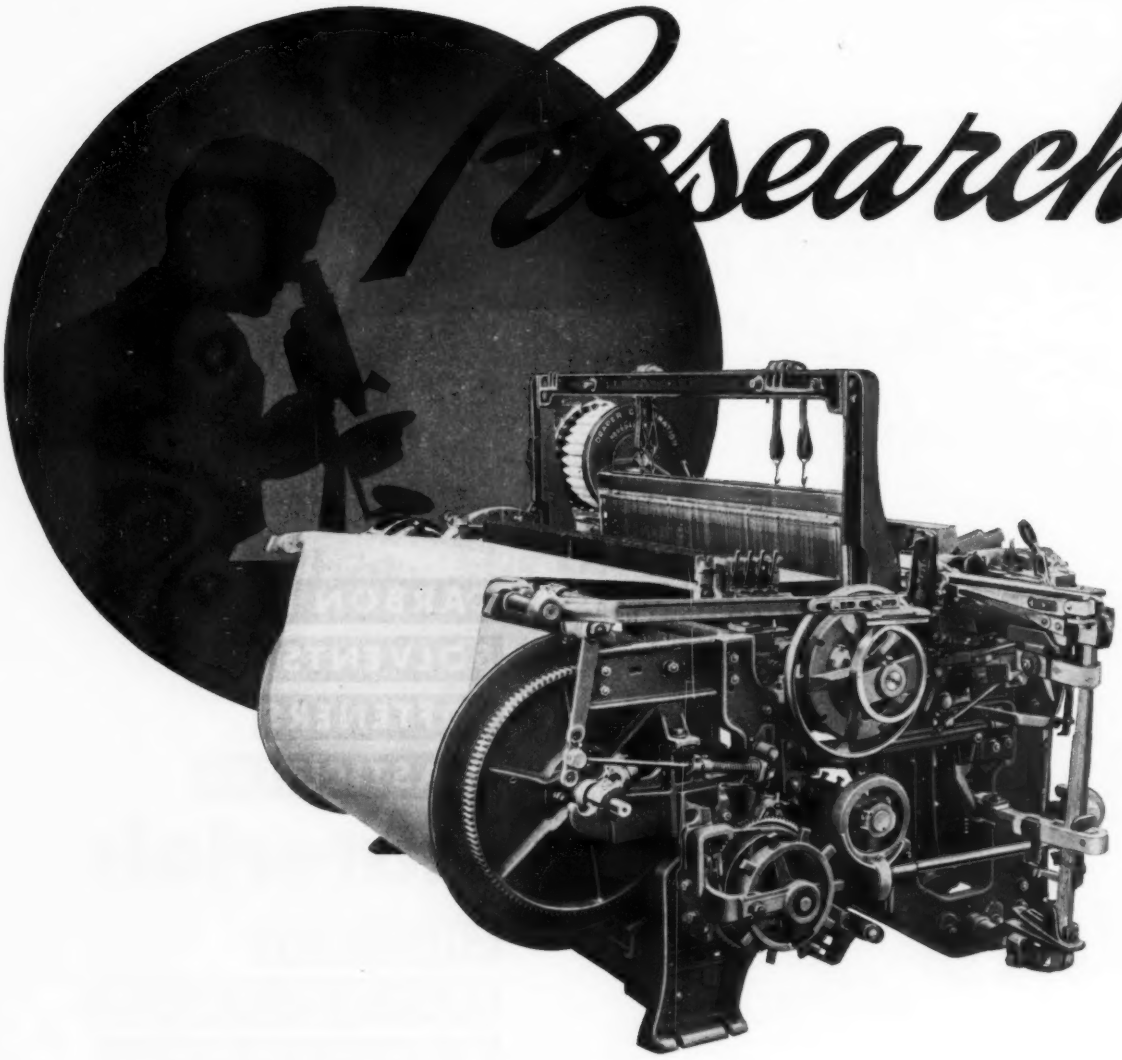

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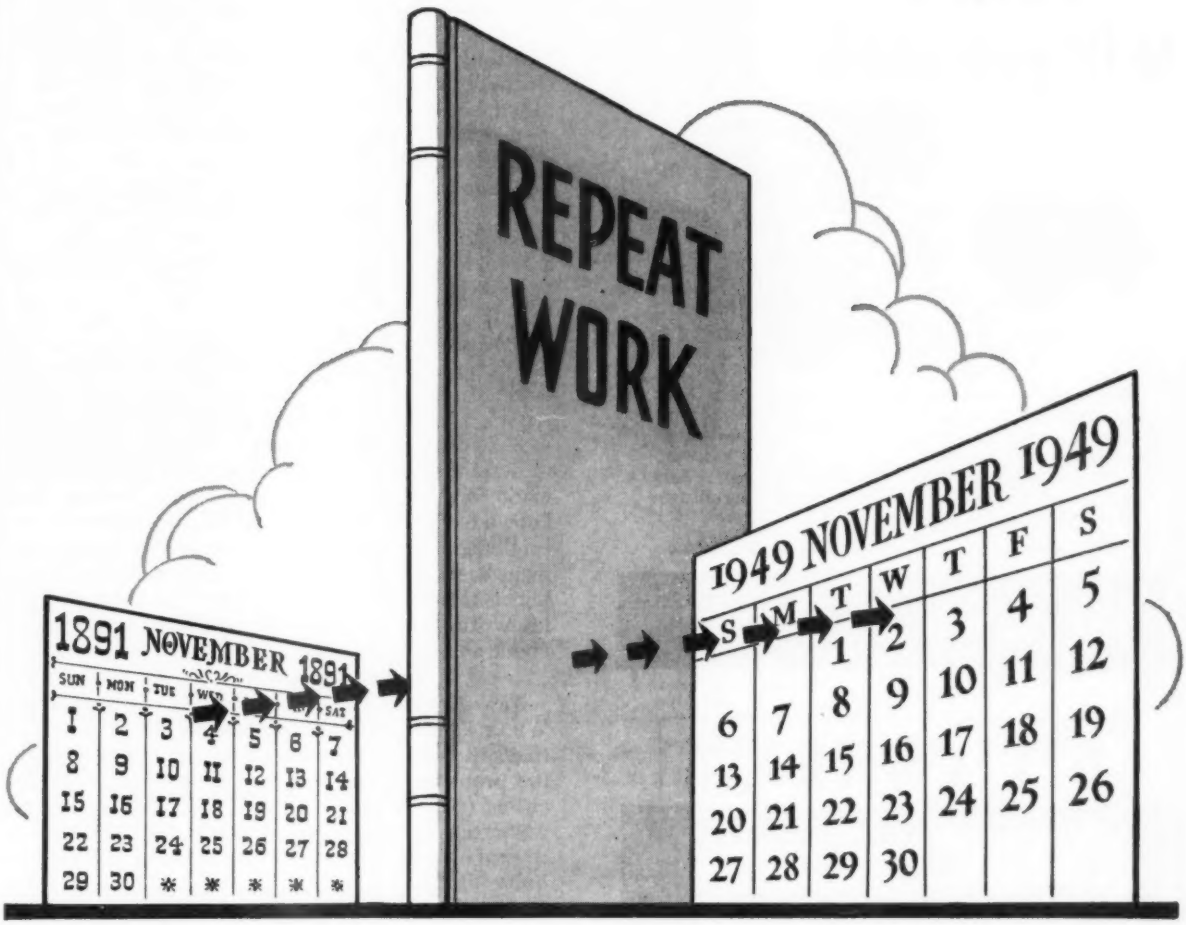

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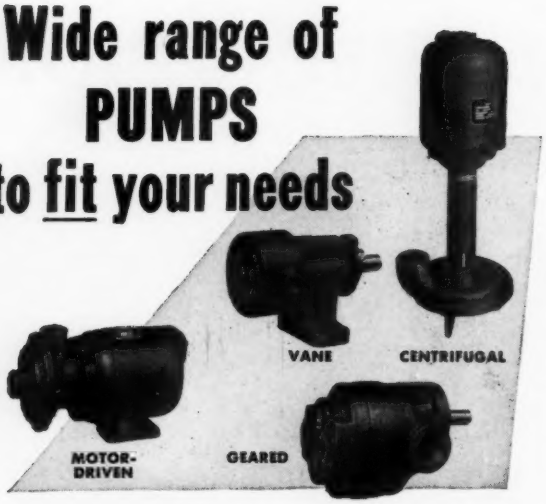

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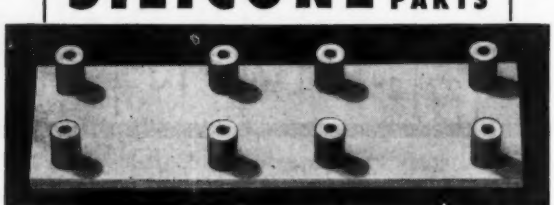

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THE TABULAR VIEW

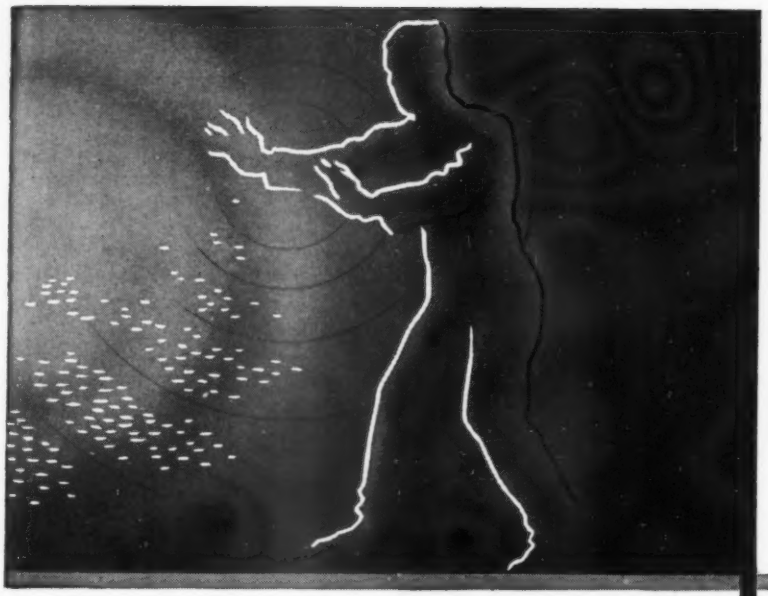
Wagging Tongues. – Drawing upon a good deal of personal experience, JULIAN A. JOFFE, '24, presents a study (page 88) of the effectiveness of gossip as a means of bringing about conformity to a locally established and accepted pattern of behavior. Following graduation from M.I.T., Mr. Joffe became a student in the New School for Social Science, and a professional engineer in 1931. At present he is a consulting industrial engineer in the confectionery field, a partner of J. A. Joffe and Company of New York City, and active in promoting facilities for higher education in Westchester County.

A New Look. – Almost three quarters of a century ago, John J. Montgomery conducted experiments with homemade gliders, the success of which is variously reported in historical chronicles. In the light of subsequent aeronautical progress and development, FRED C. KELLY takes a new look (page 92) at the claims made for Montgomery's achievements. Perhaps best known to Review readers as biographer of the Wright brothers, Mr. Kelly began his career as a newspaperman, became a world traveler, and later devoted his talents to book writing and farming. For the most part, his writings have treated human relations and economic and social conditions.

New Moon. – In the opinion of some, including WILLY LEY, an artificial satellite for the earth is distinctly possible in the reasonably near future. Some of the problems of creating such a new moon are discussed (page 93) by Mr. Ley, long a student of, and writer on, rocket developments. Mr. Ley is author of several unusual books, the latest of which is *The Conquest of Space* (beautifully illustrated by Chesley Bonestell) whose general theme is much the same as that of his article in this issue. Mr. Ley is a frequent contributor to The Review which he serves as editorial associate.

Ten-Foot Eye. – Another of The Review's editorial associates, DAVID O. WOODBURY, '21, tells the interesting story (page 96) of progress under way to build a 120-inch telescope for the University of California, using a 10-foot Pyrex disk which served temporary usefulness in the 200-inch reflector at Mount Palomar. Trained in electrical engineering, Mr. Woodbury for many years has been a free-lance writer on scientific and engineering topics for national magazines. He is author of several volumes, including *Builders for Battle* and *The Glass Giant of Palomar.*

Keep 'Em Flying. – A few of the methods which modern air lines employ to minimize grounding time for overhaul and repairs on airplanes are discussed (page 85) by C. E. PATCH, '02, Treasurer and Industrial Engineer for the Morton C. Tuttle Company of Boston. Since his graduation from the Institute, he has had extensive experience in industrial management in plants all over the world.



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MAIL RETURNS

Entry for the *New Yorker*

FROM C. E. PATCH, '02:

I have been reading the November, 1949, issue of The Review and a paragraph on page 29 has me buffaloed. What is the correct reading, please?

Boston 16, Mass.

[The garbled version of Dean Bunker's article, "Graduate Study at M.I.T.," as given in the paragraph at the middle of the first column, page 29, should have read:

The academic excellence of the work of foreign students currently registered is shown by the fact that fellowship and scholarship aid for which all graduate students compete on an equal basis has been won by as large a proportion of foreign students as of our own citizens. This is a healthy situation.

We hasten to add, quite unnecessarily we hope, that although making a suitable entry for the New Yorker, *last month's printed version hardly represents a healthy situation. — Ed.]*

Welcome — of Course

FROM CHARLES G. GLUECK, '34:

Would you be kind enough to tell me whether The Review is interested in having articles contributed by Alumni, and, if so, what procedure should be followed?

Philadelphia 26, Pa.

[Mr. Glueck's letter provides an opportunity to remind all Review readers that manuscripts on any topic likely to be of interest to Technology Alumni (or others whose training has been in one phase or another of science, engineering, and architecture) are most welcome. Suitable manuscripts are acceptable from M.I.T. graduates or others. Articles should preferably deal with some phase of science, engineering, or architecture, or with the social and economic aspects of technology. Manuscripts should be typed double space and submitted to the editor.

It may be well to add that The Review is interested in striking photographs as well, and welcomes 8 by 10-inch glossy prints from its readers. — Ed.]

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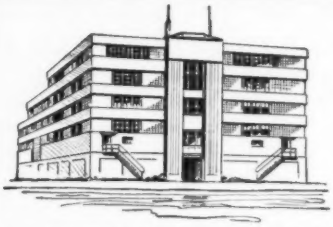

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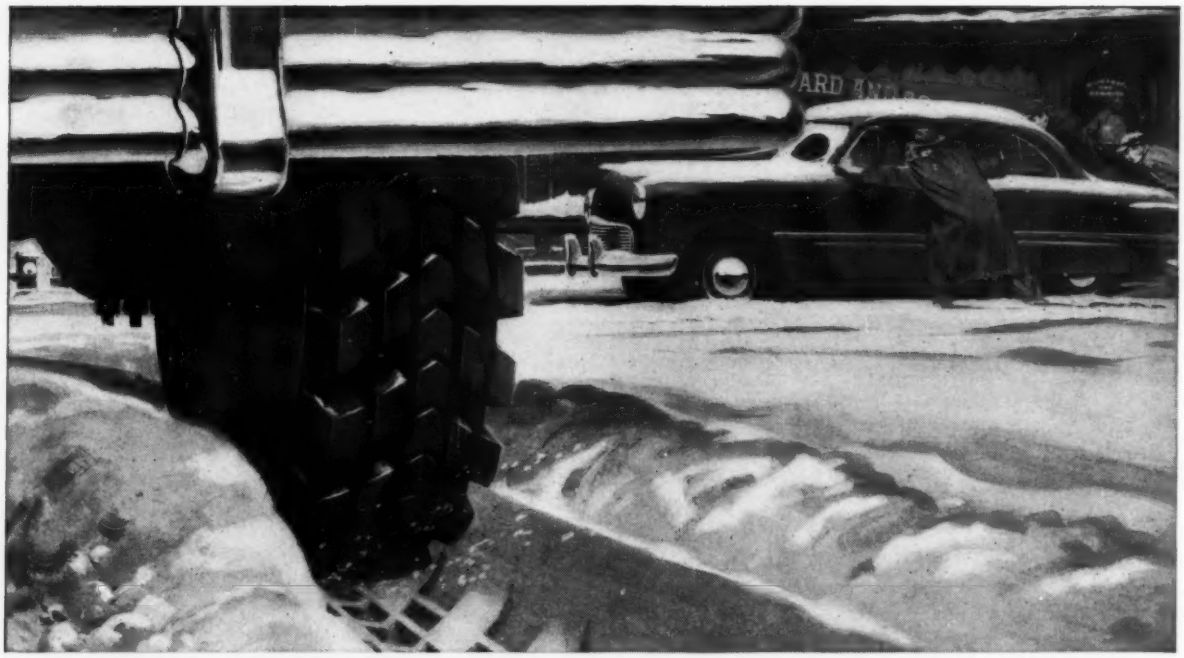

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F. Alexander Magoun, '18
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Ex Libris

By S. M. Hall

The spirit of the preservation of learning, as expressed by medieval monks, is captured in this photograph which Mr. Hall included in a one-man show exhibited at the Institute.

THE
TECHNOLOGY REVIEW

Vol. 52, No. 2 December, 1949

The Trend of Affairs

The Nation's Appreciation

EARLY in November, newspapers throughout the country printed the news of the resignation of Karl T. Compton as chairman of the Research and Development Board of the Department of Defense, and President Truman's acceptance "with utmost regret." For more than a year, Dr. Compton had filled this important post in Washington with his usual distinction, and at considerable sacrifice to his health, and now looks forward to a well-earned rest which is long overdue. Indeed, it is no secret that, a year ago when he was named chairman of the Corporation and was succeeded by James R. Killian, Jr., '26, as President of M.I.T., Dr. Compton had hoped to relinquish some of his burdens and devote a greater portion of his time to the Institute than had been possible since the beginning of World War II. Instead of finding the freedom to carry out such a program, he was once again called to serve the nation in a strenuous and difficult post no qualified patriot could refuse.

In his letter of resignation to President Truman, dated November 2, Dr. Compton made a number of observations regarding his year's work which should be heartening to the citizens of the United States. In part, his letter stated:

> Based on the sound foundation established under Dr. Bush, the Board has made some important new contributions, during the past year, to the administration and planning of our national defense program. For the first time it has made available to the Joint Chiefs of Staff a complete report on the status of every research and development item which may be important in future military strategy, with estimates of performance characteristics and dates of availability. . . .
>
> For the first time, it has been possible to recommend to the Secretary of Defense, in connection with the plans for Fiscal 1951, a budget for research and development which is not based, as in the preceding years since the war, on the accidental factor of temporary shortage of research personnel, but on carefully considered estimates of the military importance and technical feasibility of specific projects, all within realistic financial limits. This point I consider of great significance, and I hope that henceforth this portion of our military budget can be determined on the basis of military value in the light of national policy, rather than by the more arbitrary standards which of necessity had to be applied previously.

The work under Dr. Compton's direction for the past year was recognized in President Truman's reply, which stated in part:

> For many years your grateful countrymen will remember your extraordinary contributions to the national security through your service as Chairman of the Research and Development Board of the Department of Defense. Not less remarkable than the things which you have accomplished personally are the things which you have helped others to accomplish and the outstanding over-all results which have been achieved under your leadership. For all this you have earned a debt of gratitude difficult to estimate and impossible to repay.
>
> My deep concern for your health leaves me no alternative but to bow to medical advice and with utmost regret to accept, effective upon the qualification of your successor, the resignation as Chairman of the Research and Development Board which you tender in your letter of this day. . . .

And now, what of the future? For the moment, at least, Dr. Compton is planning a long-delayed vacation which has been justly earned. We wish him all the rest – and privacy – to which he is obviously entitled. Shortly after the new year, he will return to resume active participation in M.I.T. affairs to which he has already given two decades of devotion.

It is fitting, we think, to take this opportunity to recognize the many contributions which Dr. Compton has made for the citizenry of this country, not alone in his war service, but equally well, in the training of those students who have passed through the Institute during his presidency. Naturally, The Review

might be expected to have a prejudiced view on such a topic. We turn, therefore, to the Boston *Herald* for November 8, to quote a portion of an editorial which our neighbor publication ran under the heading, "Thanks to Compton." Says the Boston *Herald:*

For eighteen years, including the war years, Dr. Compton was president of the Massachusetts Institute of Technology, a job big enough to absorb the best that any man can give. But during World War II, he made M.I.T. one of the major scientific research resources of the national war machine. . . .

As if his war service had not been enough, he gladly consented to head the new peacetime scientific organization of the Defense Department, although we suspect the job was represented as being much less of a strain than it turned out to be. Not including atomic appropriations, this organization is spending something like $550,000,000 a year for research, under his direction until Nov. 3. It had 13,000 projects on its research list, not all of them active.

At the time of M.I.T.'s Mid-century Convocation last summer, Dr. Compton told a friend he had just completed a trip bringing to 500,000 miles the distance he had covered between Boston and Washington on official business. . . .

Here is selfless, and perhaps needless devotion to one's country. No gold braid, no fancy uniforms, but just long, hard plugging, mostly behind the scenes in the interest of national security. We think the country should take notice.

We wish for Dr. Compton a good rest, a hasty recovery, and the knowledge that his sacrifices were appreciated by his fellow countrymen.

Although the Institute's Faculty and staff are proud of Dr. Compton's latest patriotic service, they are also anxious to resume the warm personal association with him which the war interrupted. All look forward to his early return to M.I.T.

The Case of the 12th Harmonic

As engineers have progressed toward more efficient and less costly machinery, speeds and loads have increased. So have vibration and its symptom, noise. When stresses due to working loads are already close to safe values, there is little reserve left for added stresses caused by the superposition of unexpected vibration, and failure has often resulted. As for noise, it can be, in itself, a nuisance of the first order, even with machinery that is operating quite smoothly. When a bent shaft, an out-of-balance rotor, an inaccurately cut gear, or some other generator of vibration is present, noise can rise to unendurable levels, even as high as 120 decibels.* Such noise production is generally an indication that prompt remedial action is needed immediately. Vibrations plague many fields of engineering, particularly where high speeds and dynamic loads are present, as is typified in the engine rooms of ships. Aside from its reflection on the mechanical integrity of the power plant or the comfort of the passengers, noise can be, in case of war, a deadly clue to a ship's location for an enemy with good listening equipment.

When an acute vibration problem does arise, the job of isolating the offending member out of a welter of whirling shafts, couplings, gears, and rotors is apt to be as baffling an exercise in elimination and deduction as the unraveling of the most complicated mystery. An incorrect diagnosis is apt to be just as embarrassing. To dismount a large gear and recut it, on the grounds that inaccuracies in its teeth are causing the vibration, is a fairly large undertaking. If the noise remains after the gear is remounted, any shipowner of less than angelic character might take a dim view of the proceedings.

Essentially, the first step in tracking down a vibration is to make a wave analysis of the noise, separating it into the various frequencies that compose it, and noting, of course, those that are dominant. In the past the wave form of the noise was recorded on paper or photographic film and then subjected to the tedious procedure of Fourier analysis. Later came the cathode-ray oscillograph by which it is possible to recognize quickly, and with high accuracy, whether a given frequency component of the noise is an even multiple of a selected shaft speed. Comparison by this method is limited to frequencies that are not more than about 40 times the speed of the shaft. On-the-spot comparison is permitted, and suspicion can immediately be focused on the few members which are capable of producing the dominant vibrations.

In a paper on "Vibration Diagnosis in Marine Geared Turbines," H. G. Yates describes a new instrument, known as the wave correlator, which permits accurate, rapid, and simultaneous comparison of the frequencies in the noise spectrum with as many as four shafts or other revolving parts.

Experience has shown that a first multiple vibration is due generally to an eccentricity of some sort, that is, an unbalanced rotor. The presence of a second harmonic generally indicates a bent shaft or some ovality. Higher harmonics may be associated with the number of teeth on a gear or even with the number of teeth in the hob that cut the gear. The bolts which hold a coupling together can give a vibration that is an exact multiple of the shaft rotation, and if the coupling is misaligned, harmonics can form. The technique is sufficiently complicated so that case histories are essential for a clear understanding, and Yates gives a few from marine practice.

In one of these cases quoted, blade failures were occurring in one expansion stage of the high-pressure turbines in certain vessels of a class, but not in all. The gearing was noisy, and it was thought that perhaps the turbine blades were resonating to some vibration set up by the gear teeth. The use of an oscilloscope showed that one of the dominant frequencies was the 12th harmonic of the high-pressure turbine shaft. A glance at the shaft showed that it was con-

* Strictly speaking, the decibel (abbreviated db) is the 10 times common logarithm of two-power ratios and cannot be used to express absolute values of power, energy, voltage, or current. But if some arbitrarily established value of power is used as the reference, any other value of power can be expressed in decibels above or below the reference level. In acoustics, reference level (0.002 dyne per square centimeter) represents a sound which is just audible at 1,000 cycles per second. If this value is used as the zero reference level, 120 decibels would represent a power level of 200 dynes per square centimeter. On occasions, the noise of thunder and of riveting hammers has been measured as rising to 120 decibels which gives some indication of the intensity levels referred to. But it is well to emphasize that the decibel is not a unit of sound or noise, as is altogether too commonly stated.

Photos by C. E. Patch, '02

The economical operation of air lines depends upon keeping time for airplane maintenance to a minimum. The illustration above shows line work being done on an apron at the overhaul plant at Kansas City, Kansas, to keep the Trans World Airline fleet of transports in trim with a minimum of lost time.

At Miami, Fla., an airplane of the Eastern Air Lines (above) *is being dismantled in preparation for complete check-up and overhaul. Engines have already been removed from the wings for replacement. In the overhaul hangar at Kansas City, Kansas* (right), *Trans World Airline makes use of permanent work platforms under the wings of transport airplanes to facilitate performance checks, repairs, and maintenance of its transport airplanes.*

nected to its primary gear by a 12-tooth coupling; the gears themselves were not to blame. Sister ships with a 12-tooth coupling of different design were free of blade failures.

In another case of turbine blade failures, however, dominant multiples of 50 and 125 were immediately isolated by the wave correlator. Both harmonics were traced to errors in the hobbing machine that had cut the gears.

Ounce of Prevention

By C. E. Patch

True today, as ever it was, is the homely old proverb that a stitch in time saves nine. The maxim of grandmother's day points up the moral that repairs made while an injury is slight eliminate major damage at some future time. In grandmother's time the adage was limited in its application to wearing apparel, but today it has application to all manner of articles, including the airplane.

The airplane is a piece of equipment that will pick 60 or so people up and hurtle them through the air at speeds which would have made grandmother gasp. One of these chariots may cost a million dollars or more with a large additional amount added for spare parts. The only time when it can contribute to the income side of the air-line budget is when the airplane is in the air. Thus it is axiomatic that high utilization of equipment is necessary to the profitable operation of an air line. A companion adage is that planes must be well maintained to be safe.

The air lines themselves are doing everything in their power to meet the requirements of the first axiom, and the Civil Aeronautics Administration is seeing to it that in doing so they also meet the requirements of the second.

The Civil Aeronautics Administration has set up certain minimum requirements for all airplanes flown by licensed operators. These requirements cover not only the airplane proper, but the engines, accessories, and equipment. When a new or newly overhauled plane has had 50 hours of flying time, certain specified checks must be made. When 125 hours of flying time have passed, a second set of checks must be made, and at 250 hours still other checks are required. To make these checks there must be certain person-

nel and equipment available at the point where the airplane lands at the expiration of the various flying-time allowances. There are, however, further demands made by the Civil Aeronautics Administration which require more personnel and equipment. For instance, after some 800 or 900 hours the engines must be overhauled, which means that they must be removed from the airplanes and carefully checked in a time-consuming operation. For economy of operation, no airplane could be permitted to sit on the ground while its engines were being overhauled, or even long enough for the break-down and build-up of the power plant or "egg" as it is sometimes called. This egg is an assembly of the engine, together with certain accessories and equipment, in a frame which can be attached as a unit to the wing or fuselage. At the point where power-plant replacement is done, therefore, spare units, all assembled and ready for attachment, should be on hand. After some 8,000 or 10,000 hours of flying time, the airplane itself must have a complete structual inspection and overhaul.

The maintenance and repair of airplanes thus constitute a problem in the safe and profitable operation of air lines, all of which have developed methods of servicing planes with a minimum reduction of flying time. To this end it has been found economical for each line to provide centralized maintenance facilities at some suitable point on its routes and to schedule the flight of its airplanes so that each will be arriving at the central maintenance station in time for major inspection, servicing, and overhaul. To one who has grown up with construction schedules or with the customary methods of transportation, the tempo of airplane flight and maintenance scheduling is a bit quicker than presto.

The familiar line, "Time is of the essence of the contract," in airplane maintenance becomes, "Time is of the essence of the contact," and everything is done to reduce to a minimum the time an airplane is required to remain in a check-up or overhaul berth. Some of the means to this end are interesting.

A number of overhaul hangars have electrically operated work platforms hung from the overhead structures so that the platforms can be swung down quickly under the airplane's wings, and thus save the time and man power necessary to rig them from the floor. In other hangars, airplanes are towed into permanent platforms set up for each type of airplane and castered stagings are moved in while the fuselage, wings, and other parts are inspected. Some plants schedule each operation as to time and man power on a horizontal line chart. This schedule is mounted on one face of a swiveled panel in the wall of a planning or production booth from which the overhaul is controlled.

Additional economy is effected by preparing the service point for airplane arrivals. Prior to the arrival of the airplane, a planning clerk draws from stores all the accessories and equipment known to be needed for the overhaul. These are properly tagged with yellow tags and arranged in a castered bin to be placed adjacent to the plane when it is towed into the overhaul berth. The accessories and equipment removed from the airplane are marked with green tags and are exchanged for the yellow-tagged material, thus saving valuable service time. The green-tagged items are later taken to the proper departments for overhaul, test and return to stores, and are worked on without losing flying time.

The economies of operation resulting from such forehanded planning are considerable and can easily make the difference between profitable and unprofitable operation of an air line. It is even possible that some of the lines have become so proficient at overhaul operations, and have gained such a high utilization of their equipment, that they might operate at a profit without the government subsidy.

It's in the Bag

GRANDMOTHER was accustomed to purchase most of her victuals in bulk lots from the general store. She would bring along her own container for a quart or two of milk, confident that all traces of its contents from the last shopping trip had been removed. She was not adverse to weighing out the required amount of flour, sugar, or beans which her large family required. The ever-present cracker barrel, around which the townspeople discussed their crops, the weather, and political issues, yielded its product to grandmother who carried away her purchases wrapped in newspaper. If her grocer were a really progressive merchant, possibly a fresh, brown paper bag would be substituted for last week's newspaper.

But mass production, improved sanitation, and standardization have changed the ways of a former generation. In contrast, today's housewife need feel no concern lest the milk taste of kerosene, for she seldom, if ever, buys food in bulk. Instead, she finds that her food products have been accurately weighed and packaged in attractive and convenient containers which protect their contents until ready for eating.

This change in merchandising methods, which science and engineering have made possible, benefits the American family in several ways. Prepared foods reach the American table fresher, crisper, and cleaner than was possible half a century ago. In addition, there is less waste, and the quality of products is uniformly high, instead of depending upon the vigilance of the local merchant.

A recount of the progress which has been made should not dim perception of present needs, however, nor should it blind us to tomorrow's potentialities. To assure that this does not occur, America's food industry continues the search for still better ways of bringing palatable nutriment to the tables of the world's people. Its extensive research organizations and facilities are not alone carrying out this program, but are supplemented by those of many of the country's colleges and universities.

Needless to say, the Department of Food Technology at M.I.T. is making its own contributions to the betterment of the world's food products. One would naturally expect to find studies in biochemistry and flavor, in refrigeration and dehydration, playing the leading roles in the Department's research program, and such is, indeed, the case. But science, like politics, often breeds strange bedfellows. It is not surprising, therefore, that some of its ancillary research projects

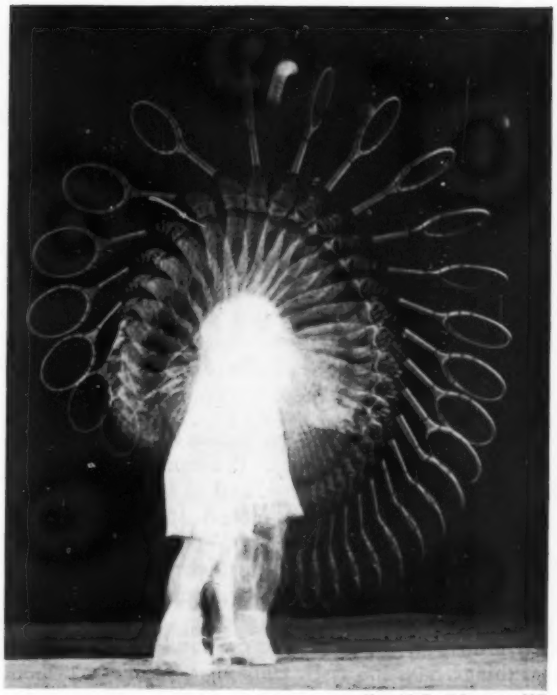
are quite as interesting and important as those which are obviously along the main stem.

For years, processed foods have been sterilized by application of high temperatures for varying periods of time. But sterilization by dielectric heating, or by irradiation with x-rays and cathode rays, also shows promise of being equally effective. Furthermore, these methods give promise that sterilization may be accomplished after foods have been packaged, thereby removing any possibility of contamination so long as the container is properly designed and made, and reaches the ultimate consumer in good condition. Similarly, the steps which popularized quick freezing permit processing to be done after packaging.

Before such promising processing methods can be used on a large scale, however, it is necessary to know how they may affect food flavor and preservation. It is also necessary to know how the processing of packaged foods is likely to affect the properties of packaging materials with which foods are protected. Will sterilizing rays affect the molecular structure and alignment of packaging materials? Will they alter the permeability and porosity to gases and water vapor? Will they produce minute perforations or cause brittleness and cracking? How shall the properties of packaging materials be tested, specified, and standardized so that results from different laboratories may be correlated?

Questions such as these are under investigation in the Packaging Research Laboratory, which is directed by Professor Bernard E. Proctor, '23 and Arthur H. Landrock, '49. During the past year investigations on the permeability of packaging materials to water vapor and other gases, and on the effect of a fumigant (ethylene oxide) on transparent food-packaging materials have been carried out.

Much of this work (particularly the studies on permeability to water vapor) has been conducted in cooperation with the Packaging Materials Testing Committee of the Technical Association of the Pulp and Paper Industry. The need for such industrial association co-operation becomes apparent when it is recognized that data thus far obtained by different investigators are expressed in different ways and, at present, the results from one laboratory cannot be correlated with those obtained in other laboratories. Moreover, none of the methods which has been used so far for testing the permeability to water vapor at freezing temperatures is sufficiently developed and universally used as to warrant adoption. Tests by individual manufacturers of packaging materials differ widely, not alone in the measuring techniques used, but in the results obtained with the same materials. It follows that there can be no science in a field in which no consistent measurements are obtainable. Thus, one major aim of the present research of the Packaging Research Laboratory is to investigate the presently used methods of testing packaging materials, to correlate the different types of measurements now in use, to develop a uniform method of testing which correlates results obtained by different techniques, and to foster standardization in the testing of packaging materials through the development of a uniform test procedure.



Harold E. Edgerton, '27

Professor Harold E. Edgerton, '27, of the M.I.T. Department of Electrical Engineering, made this interesting multiple-flash picture with techniques which he developed. No headless horseman but, like a peacock preening, the swirling arm is that of the famous French tennis player Robert Abdesselam.

No one can foretell, with certainty, what will be the outcome of such investigations. Although appearing more or less routine to the casual observer, nevertheless work in progress gives promise of fundamental importance to the human diet. But of one thing we can be reasonably sure. Success, like the food which grandmother brought home from the general store, is "in the bag."

Tin Used to Make Gasoline

DEVELOPMENT of an economical way to speed the conversion of soft coal to synthetic gasoline and oil has been reported by United States Bureau of Mines chemists. The crux of the new technique is a catalyst, or chemical accelerator, which paradoxically contains substances that by themselves interfere with the synthesis of liquid fuel.

Investigations showed that tin is a fairly active catalyst for promoting the direct combination of hydrogen with bituminous coal of the Pittsburgh seam type to form liquid fuel; but acids containing chlorine proved worse than ineffective; they retarded the process.

A mixture of tin with a chlorine acid, however, is probably the best catalyst available, although carbon tetrachloride or any other material which generates chlorine acids can be employed. Under appropriate conditions it has been found possible to replace 90 per cent of the tin by zinc, which is much more available in the United States, without appreciable loss of catalytic effectiveness.

Gossip
AS AN ELEMENT OF SOCIAL CONTROL

This Study of the Factors Comprising Gossip Aims to Answer the Famous Query, "What Will Mrs. Grundy Say?"

By **JULIAN A. JOFFE**

ONE of man's innate tendencies expresses itself in a desire for security.[1] It becomes apparent in his inertia to change, and in his reluctance to accept anything new and untried. It is very evident in his basic social conservatism. Thus, often, the very poor are the most stubborn in their ways! They fear the unfamiliar; they dread to lose what little they might have been able to acquire.

On the other hand, they know and believe in familiar things. Says Frank H. Hankins:[2] "Men everywhere have a strong feeling of security in the familiar; hence they hold on to their traditional beliefs and ways tenaciously. . . . It includes . . . the desire for the security of the self as it is pictured, idealized, and cherished by one's self."

To sustain life, people find it behooves them to unify or integrate it. They must maintain and discover ways of retaining what they have acquired. Various devices are employed by man to accomplish these ends, among which tools gossip serves as a potent social force of control.

We may observe, as has Joseph S. Roucek,[3] that: "Social control is a collective term for those processes, planned or unplanned, by which individuals are taught, persuaded, or compelled to conform to the usages and life-values of groups." The aims of social control are therefore, obviously, "to bring about conformity, solidarity and continuity of a particular group or society."[4]

Gossip is a universal and powerful societal tool. We all dislike to be "talked about" because we cherish social approbation and fear disapprobation. "Gossip is, as a rule, a sufficient instrument of control in small local groups, where the behavior, and even the attitude of each is known to all. It is of little importance in the large city, where the sense of community is lost. This is one of the primary reasons why urban centers must have large numbers of police, in spite of whom they become the chief centers of crime, delinquency, vice and corruption, and other forms of antisocial behavior in civilized societies."[5]

Although he does not specifically mention gossip, no doubt Edward C. Hayes[6] could include it among his extralegal aspects of social control. For him, public opinion is the most significant and potent form of all the varieties of social control. He says: "Public sentiment remains the most original and persuasive and probably also the most powerful of all agencies of social control by sanction. It is capable of progressive development, as the experience of ages becomes crystallized in definite judgments, incorporated into the "common sense"; as newly developed possibilities of good and evil become more generally understood; as the general level of personality is raised by the agencies of education; and as the method of organization gives increasing definiteness and publicity to social responsibility."

In his classic work, *Social Control: A Survey of the Foundations of Order*, Edward A. Ross does not include gossip among his 14 headings of the means of social control.[7] However, in the work of Frederick E. Lumley it is found among his forces, as a negative means involving repressive action by restraint or counterconditioning.[8]

"While some 'gossip' may be innocuous, that which concerns social control is largely critical in tone. Gossip helps make myths and legends and is effective in formulating public opinion. Gossip is the 'voice of the herd,' thundering in our ears, telling us that the goblins of ridicule, ostracism, and punishment 'will get us' if we don't behave."[9]

Closely associated with gossip as a tool of social control may be enumerated praise and flattery, although they are employed in a positive sense rather than in a negative manner. Whereas, gossip is indicative of a reproach, the other two connote "a sort of reward in words, especially from upper to lower strata and induce social amenability and conformity."[10]

There are additional aspects of this problem of equal importance. "Calling names or hurling epithets, especially at others whom one dislikes is an old device of control."[11] This form is not too dissimilar in character from gossip, although the former is employed vis-à-vis, while the latter usually is more generally conveyed through several parties. More direct types of verbal controls are commands, threats, and censorship. These are, of course, based upon force and power and indicate impending restraint unless conformity results. The individual has to choose from two alternatives: to comply, or to suffer for his acts. There is no subtlety!

It might be fruitful to learn the significance, meaning, and derivation of the word "gossip" and thereby to arrive at a better understanding of the term and its current usage. For this the *Encyclopaedia Britannica* has the following to say:[12]

Gossip (from the O.E. *godsibb, i.e.*, God, and *sib*, akin, standing in relation to), originally a god-parent, *i.e.*, one who by taking a sponsor's vows at a baptism stands in a spiritual relationship to the child baptised. The common modern meaning is of light personal or social conversation, or, with an invidious sense, of idle talebearing. "Gossip" was early used with the sense, of a friend, or acquaintance, either of the parent of the child baptised or of the other god-parents, and thus came to be used, with little reference to the position of sponsor, for women friends of the mother present at a birth, the transition of meaning to an idle chatterer or talker for talking's sake is easy. The application to the idle talk of such persons does not appear to be an early one.

At this point, I believe it would be appropriate to distinguish between gossip and another word that is frequently confused with it. Reference is made to rumor. From the dictionary[13] we learn that rumor is derived from Old French, French, and Latin words meaning noise, prolonged and indistinct. From this basic meaning rumor degenerated into terms signifying: (1) "A flying or popular report; the common talk; tidings; hence, public fame; notoriety; reputation." (2) "A story or report current without any known authority for its truth." (3) "To noise abroad." (4) "To give out tidings of."

A writer on rumor has defined it as "a specific (or topical) proposition for belief, passed along from person to person, usually by word of mouth, *without secure standards* of evidence being present."[14] In every rumor there is the implication that some truth is being communicated.

In spite of its unfavorable aspects, there is, strangely enough, at least some understandable basis for rumor. Allport[15] remarks: "One of the most important psychological sources of rumor is peoples' desire to understand and to simplify the many complicated events and developments which follow each other, often with bewildering speed. Rumor serves to make things simpler than they actually are." Rumors "are spread to relieve, justify and explain . . . underlying emotional tensions."[16] Gossip, on the other hand, is employed against an individual who has strayed from the fold or group. It is used to bring him back into conformity with group behavior.

Nature of Gossip

Through its very nature, gossip is efficacious only where people are neighbors or circulate in relatively close and self-contained units. If strangers live in close proximity, verbal castigations or efforts at intimate social control become meaningless, because the people do not know each other sufficiently for any effectual results, and they care less. Thus, gossip has little force in urban centers of concentrated population, unless it be within small circles, associations, churches, or other groups bound by some especially intimate ties. Its greatest sphere of value is found in relatively sparsely settled communities, where people are neighbors and each knows the other's business. For its greatest effect, gossip requires that people meet on numerous footings: social, political, religious, communal, civic, and so on. "The gossipy restraints of small town life are absent in the apartment house."[17]

Gossip is expressed intolerance for the nonconformist. It connotes a degree of personal insecurity on the part of the conformist who betrays his fears for his own position and for that of the group of which he is a member. It functions to better advantage in rural areas or less densely settled localities. On the other hand, "In the city it is news rather than rumor, publicity rather than gossip, that bind the varied social groups."[18]

Personal insecurity, although the important factor implicit in gossip, is closely associated with the degree of antagonism that exists toward the individual who strays. The degree of animosity is conditioned by the intensity of the insecurity. However, it is a fact that people may be close friends and yet disagree vehemently on certain fundamentals. Such friends would not normally gossip about one or the other, for the sacredness of friendship would interfere. It would therefore appear that gossip, conditioned by personal insecurity, depends upon dislike and antagonism for its employment.

From the above observations I should like to suggest a formula that seems to express the relationship existing between gossip and personal insecurity, antagonism, and solidarity of the people involved. There is no attempt to convey or hint that gossip can be measured in absolute terms. Since gossip results from emotions and is dependent upon human forces it could not be quantitatively evaluated with any degree of fineness. However, the resultant gossip can be roughly stated as being intense, severe, mild, negligible, and so on. Personal insecurity, antagonism, and solidarity would be restricted and qualified in the same manner. Of course, there are those who believe that the social sciences can be studied and analyzed

Harold M. Lambert

with the same degree of perfection as the physical sciences, but to that school of thought the writer does not subscribe.

It appears that the amount of gossip engendered by a particular set of circumstances is directly proportional to the personal insecurity of the gossiper, his antagonism toward the dissenter, and his solidarity. Thus, in symbolic notation:

$$G - I \times A \times S$$

where G represents the magnitude or effectiveness of gossip generated

I represents the personal insecurity on the part of the member of the group

A represents the antagonism felt toward the dissenter, and

S represents the solidarity within the given social group

Conclusions Evident from the Formula

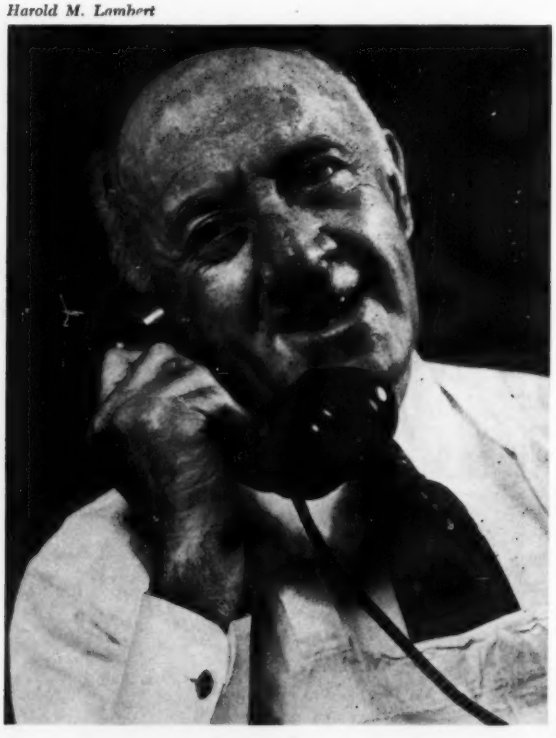
Gossip is ineffectual unless all three factors are present. The intensity of the gossip depends upon the magnitude of the factors in the social configuration.

For people closely knit within any group, this expression of severe antagonism toward one member who engenders great personal insecurity upon the others would result in gossip of a virulent nature.

With an absence of solidarity (as in an apartment house) there would be no gossip, although antagonism and insecurity might be present, for there would be no effective way of influencing the disturber to cause him to mend his ways.

For the gossip to achieve its purpose, to accomplish the degree of social control desired, the object about whom there is discussion must respond and conform.

Harold M. Lambert



Consequently, to be meaningful, the formula should be duo-directional – the behavior of the erring one must be expressed therein for him as well. The effect of the gossip is, therefore, dependent upon the personal insecurity he experiences vis-à-vis the group, his degree of antagonism toward it, and the extent of his solidarity toward the given social group. If, in any one of them, his attitude be completely negative, his response will be nil. Contrariwise, his behavior will be influenced in the proportion in which he accepts personal dependence within the group, approves it, and is one with it.

In *Plainville, U.S.A.*,[19] James West writes of a sociological study conducted in a small, closely knit community. Since his observations and findings are germane to this article they are to be examined briefly in relation to the previously suggested formula. Mr. West finds that: ". . . Plainville is a community in the sense that all the people who live or trade there are labelled together under the name of their town."[20]

The lot of the newcomer is difficult: "toward 'strangers' or 'outsiders' (sometimes called 'foreigners'), however, constraint or even real hostility is frequently felt."[21] The newcomer is diligently evaluated and his "ultimate full status, however, depends on the number and kind of ties he and his family are able to establish in the formal social structure of the community."[22] The stranger must cease his nonconforming ways before he is accepted: prior to that he is viewed with suspicion, resentment, and antagonism.

West's personal experiences and treatment fit into the pattern, for throughout the introductory pages to his book he speaks of the insecurity which the Plainviller felt as a result of his presence and his questioning.[23] He was viewed with "suspicion, great constraint and even resentment,"[24] but when he began to conform (with the aid of a townsman), he was accepted.[25] It must be borne in mind that for the purposes of his study it was essential that author West be "one" of the Plainvillers.

In such an atmosphere, observe what West has to say about gossip:

> The role of actual legal organization among all the other mechanisms which force Plainvillers to conform to this society's established patterns of behavior is really very slight. More important mechanisms, both preventive and punitive, for social control are gossip, ridicule and in the wildest sense of the term, folklore. These function "individually" of course, but they also function "by groups," and it is necessary to describe the organization which I shall call "loafing groups" and "gossip groups." Every Plainville group, no matter its primary function, is of course partly a gossip and loafing group too.[26]

Of one such group West writes:

> The gossip is . . . dreaded and hated. They are said to "fight every progressive thing in the community" . . . they are against schools . . . against good clothes . . . against being the least bit modern . . . against anybody having a good time.[27] . . . The religious control of morals operates mainly through gossip and fear of gossip.[28]

From West's *Plainville U.S.A.*, it would again appear that gossip as an element of social control originates from within a closely knit group. For its employment and efficacy, gossip is dependent upon personal

insecurity, antagonism, and solidarity. For the gossip to be worth while, it must reach the ears of the wrongdoer, otherwise it is wasted effort and useless. It is not indulged in merely to pass the time of the day, although a good deal of aimless conversation appears under the name of gossip.

The following illustrations portray cases wherein gossip was used as a potent tool of social control. The cases illustrate varying degrees of its effect, dependent upon the intensity of personal insecurity, antagonism, and social solidarity. They are culled from experiences in two communities: one of about 70,000 and the other of about 4,000.

Profitable Sale — with Drawbacks

Recently a plot of wooded ground behind the homes of several neighbors on one block was in the process of being purchased. In the midst of the negotiations, another member of the community, Mr. Z, bought it. The land in question was so situated that it could not be developed for real estate speculation except at disproportionately high costs.

When it was learned that the woods behind their homes were grabbed away from them, the feeling ran high among the several families involved. Mr. *B*, who was more incensed than the others announced that his home was being put up for sale to Negroes, unless the land were returned to the original people and at a cost no more than they should have paid. Speculative profit was to be completely omitted.

A furor of gossip burst forth within the neighborhood. The lawyer who had been the prime mover in the deal was approached by many people to forestall any unfortunate consequence. The leaders of the religious organization of which the buyer and the attorney were communicants exerted their powerful influences. The head of the realty board made numerous calls and visits.

Had Mr. *B* considered himself an integral part of the group, obviously he never would have threatened to destroy it by frightening the neighbors with the thought of Negroes living within their midst. The personal insecurity of the people within the immediate community was not vital to him, although it was a vital factor to Mr. Z. Life was made rather unpleasant for him as was evidenced by the short speech he made before the papers were signed turning over the land to the neighbors and their families. All, seemingly, accepted his protestations when he said he had never meant to make a profit from his neighbors. He claimed to have bought the land as an investment. So many people had approached him in the few weeks during which he held title that he was anxious to sell. He stated his regret that he had ever become involved in the venture, even though he had made a profit in the transaction.

Harold M. Lambert

In this instance the breakdown of sentiments of those involved in the community was as shown in the table below, in which the center column indicates the component of gossip which was effective. From this tabulation, it is clear which man gave in.

It is only fitting to recall that, although admiring Mr. Z for his general business acumen, the neighbors were much disturbed over the manner in which the transaction was conducted. It appeared to them that Mr. Z might have anticipated the concern which his actions engendered in the community and, for a time, he was mercilessly berated.

Mink — in the Morning

Mrs. *A's* husband had recently retired from business, in very comfortable circumstances. The family moved from a crowded urban section to the relative freedom of a private house, with lawn and quiet streets which were very inviting to Mrs. *A*. Undoubtedly, in her former home she had had little opportunity to walk amid trees and grass. It is to be assumed that her former associates had been somewhat slovenly, for no sooner was she settled in her new residence than she proceeded to take morning constitutionals, clad in a nightgown topped by a long mink coat. Of course her feet were shod in bedroom slippers. Apparently, neither Mr. *A*, nor their adult children saw anything incongruous in the costume.

(*Continued on page 118*)

Mr. Z toward the Community	*Community toward Mr. Z*	*Gossip Factors*	*Community toward Mr. B*	*Mr. B toward the Community*
Insecure without community	Great insecurity	*I*	Great insecurity	No concern
Desire to please	Antagonism	*A*	Antagonism	No concern
Great solidarity	Great solidarity	*S*	Great solidarity	No concern

Myths of Aviation —

Early Gliding Experiments of John J. Montgomery Are Evaluated against a Background of Seven Decades of Progress in Aeronautics

By FRED C. KELLY

EVERY so often a legendary story finds its way into print that a man named John J. Montgomery, early in the 1880's, made successful gliding experiments in California; that he made contributions to aviation ahead of the Wright brothers. A few years ago a Hollywood studio even made a motion picture that dealt with Montgomery's supposed early exploits and the publicity department of that studio sent out statements that historians must revise their beliefs about who was the real pioneer in American aviation. Fancy historians being guided by Hollywood!

The truth is that Montgomery did no successful gliding in the 1880's; no invention of his is used in airplanes today; no theory originating with him has withstood the test of time; and his work contributed nothing, either to the art of flying or to the science of aerodynamics.

Montgomery himself never claimed to have made more than one gliding flight prior to those of the Wrights in 1900. At the Chicago World's Fair in 1893, he spoke before an aeronautical meeting, but made no mention in this talk of having glided. However, he told Octave Chanute of his early glider, and Chanute recorded the facts, as accurately as he could, in his book *Progress in Flying Machines,** page 248, in 1894. Chanute reported that the glide was from the top of a hill which sloped at an angle of about 10 degrees; that it was made in a sea breeze "blowing steadily from 8 to 12 miles an hour"; that it started with a "jump into the air without previous running"; that Montgomery and his machine together weighed 170 pounds; that the wings had an "area of about 90 square feet"; and that "the total distance of the glide was about 100 feet."

Now, present-day engineers know that a glider, such as Montgomery described to Chanute, could not have gone 100 feet without a higher, much higher, relative wind velocity of eight to 12 miles an hour. Any aeronautical engineer would agree with what Orville Wright wrote in 1944,† that a machine having a wing area of only 90 square feet, with camber as used by Montgomery, cannot lift more than 20 pounds at a speed of eight miles an hour, and not more than 45 pounds at 12 miles an hour, or not more than one eighth to one fourth of the weight of Montgomery and his machine. In two later machines, Montgomery added more than 50 per cent greater wing area; but Chanute recorded that these, too, proved to be failures because not enough lifting effect could be obtained to carry the weight. If Montgomery had been able to get enough lift with his first machine, by merely making a leap without any preliminary run, why, one wonders, did he never try that machine again? Why did he add 50 per cent more surface to his next machines? Surely no engineer, in the light of present-day knowledge, would accept that Montgomery's glide could have been more than 10 or 15 feet in a machine capable of lifting only one fourth of the weight to be carried. When, 10 years after the event, Montgomery told Chanute of the glide, there had been time for the distance to grow in his recollection to the extent of 100 feet.

After another 15 years the distance of that glide grew to 600 feet! That report appeared in a book by Victor Lougheed, entitled *Vehicles of the Air.*‡ Indeed, whatever fame is attached to the name of John J. Montgomery in aviation history appears to have come almost entirely from propaganda put out by Lougheed. Lougheed's interest in aviation was not that of a disinterested historian. In the same year that he put out his first edition of *Vehicles of the Air,* he entered into a written contract with Montgomery. In this contract Loughheed agreed to finance the manufacture of power-driven or other machines, and to furnish money for the sale and exhibition of airplanes. Later he was an expert witness for the Montgomery family in a lawsuit they brought against the United States Government, which had bought planes invented by the Wright brothers. Indeed, it was believed that the praise heaped upon Montgomery by Lougheed was what caused the family to bring the suit, seeking to prove that Montgomery was a pioneer in aviation. The Montgomerys lost the suit. In handing down its opinion, the Court of Claims said: "It seems to us idle to contend that Montgomery was a pioneer in this particular art."

In 1905, some time after the success of the Wright brothers at Kitty Hawk, a glider designed by Montgomery was lifted to a height of several thousand feet by a hot-air balloon, then freed from the balloon to make a spectacular descent with a pilot aboard. Several flights were made, but on July 18, 1905, the machine turned over on its back, collapsed and fell to

(*Concluded on page 110*)

* New York: *American Engineer and Railroad Journal,* 1894.

† Letter to Major R. H. Fleet, Consolidated Aircraft Corporation.

‡ London: Benn Bros. Ltd. – T. Fisher Unwin, Ltd., 1910.

—The Satellite Rocket

Much Valuable Scientific Information Might Be Supplied by an Artificial "Moon" which Rocket Engineers Hope to Launch into Outer Space Some Day

By WILLY LEY

One of the last reports written by James Forrestal, in his capacity as Defense Secretary, contained a short paragraph, stating that official studies had been made dealing with the subject of an orbital or satellite rocket. Of the many millions of people who read excerpts from the Defense Secretary's report in the newspapers, only a very small percentage had a clear mental picture of what was meant by the term "satellite rocket." Unfortunately there is no better word for the concept involved; the term refers to a rocket which revolves around the earth like a satellite after its fuel supply has been used up. That it happens to be an artificially created satellite does not alter its astronomical status in any way.

The news of Secretary Forrestal's report, of course, was merely that such studies were mentioned in an official document; otherwise the idea was not really new. There had been a fair amount of technical literature about satellite rockets in German, beginning in about 1925 and continuing until 1936 when the Nazi Government restricted discussions on rocket research which, thenceforth, became both secret and official.

Although nothing specific has been said either in the Forrestal report or in a later official release, a difference in concept seems to be involved between the current line of reasoning and that prior to about 1936. The German literature of the pre-Hitler period dealt with manned artificial satellites, which were intended to serve as refueling stations for piloted rockets. The leading thought had been that, at some future time, rocket development must arrive at the point where a piloted rocket could take off from the earth, attain a circumglobal orbit and be able to return and land on earth, with a reserve of fuel. It was proposed to leave most of the possible excess fuel on an artificial satellite so that after a dozen or so trips to the satellite, the piloted rocket would be able to fill its tanks to capacity from the accumulated reserve and take off from the satellite for a really long trip into interplanetary space. Because all the early proposals had to assume the use of piloted rocket ships, the creation of a satellite rocket appeared possible of achievement only in the remote future. An artificial satellite was "obviously" useless without at least one observer, and an observer could reach the satellite only by piloted rocket.

But now, because of technological progress in the field of telemetering, fundamental thinking about satellite rockets has been altered. True, telemetering did exist in 1930 and even earlier, but with the exception of some early models of radiosondes, all the telemetering anybody thought of, was done (or would have been done) over a wire. Nowadays, with telemetered instruments almost common, the situation has changed. Because we now have instruments which not only register their readings but which can also report their findings by radio, a satellite rocket can be quite useful without a living observer. Therefore, a satellite rocket which can precede the piloted rocket ship becomes a technological possibility. Furthermore, the satellite rocket need be but a fraction of the size that a manned satellite would have to be. Consequently (while the piloted rocket is still a development for the future) its possibility is much nearer of accomplishment than was possible under the old proposals.

An unmanned but instrument-equipped circumglobal satellite rocket would be a valuable aid to science since it could be used to inform us about many things. Among the most obvious are: the cosmic-ray density near our planet but outside its atmosphere; the density of interplanetary gas;* the temperature a body will assume in space near earth; and the drop in temperature which takes place when it enters the shadow of the planet. It is even possible that, in a manner to be outlined later, such a satellite rocket would furnish information about the average number of impacts of meteroric dust particles of perhaps less than one-tenth millimeter in diameter.

A satellite rocket, circling the earth 300 or 800 or even 1,500 miles from its surface, is fully as subject to terrestrial gravity as a boulder at the seashore. The difference is simply that the rocket is moving with a high velocity relative to the earth, whereas the boulder is not. It is well known that any object at the earth's surface will fall some 16 feet during the first second after its support has been withdrawn. Now imagine two guns, at the same height above the earth's surface and both firing horizontally, but with different muzzle velocities. Assume that the muzzle velocities are half a mile per second in one case and a full mile per second in the other. One second after firing, both projectiles will have fallen 16 feet. If we measure the height of the projectiles above the ground at the end of the first second, we find two different figures. The projectile which was fired with the higher muzzle velocity

* The so-called "Grimminger Report" estimates a number density of 8.4×10^8 particles per cubic centimeter at an altitude of 400 kilometers (250 miles) with a mean free path of 6.7 kilometers or about 4 miles.

will be a little higher above ground than the other. The reason is that the earth is a sphere and its surface curves away from the trajectory of the projectile. The influence of gravity does not vary and the curvature of the earth is a constant. Consequently, after the lapse of a number of seconds, the projectile which has moved faster over a given distance horizontally will be higher than the slower projectile; its trajectory will be shallower, as shown in the diagram below.

Obviously there must be a horizontal velocity resulting in a curve so shallow that it matches the curvature of the earth itself. It is comparatively easy to calculate that this velocity is almost precisely five miles per second, or five times the maximum velocity of a V-2 rocket. This figure is valid at the surface of the earth, but naturally the experiment could not be actually made at the surface because of air resistance. It would have to be made outside the earth's atmosphere and at least 300 miles from the surface. In that case the horizontal velocity required would be somewhat less than the five miles per second which is valid at the earth's surface.

The orbits of satellite rockets can be calculated by well-known astronomical methods. There are, of course, an infinite number of such orbits, each orbit of specified mean distance from the earth having an orbital velocity associated with that distance, and a period of revolution which is determined by the velocity and by the length of the orbit. Sorting some of the possible orbits according to the time required for one complete revolution, we obtain the following table:

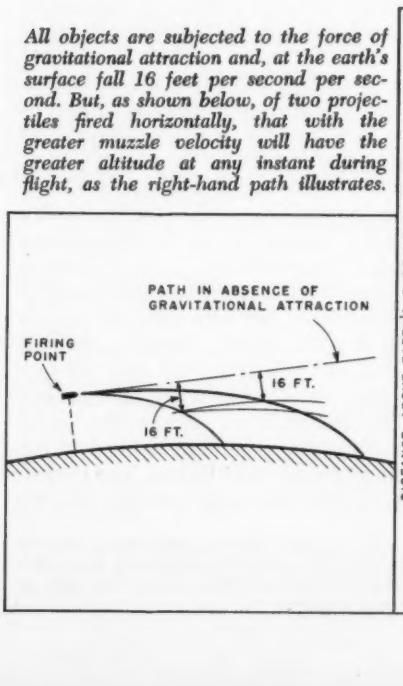
Period of Revolution	*Distance from Surface*
1¾ hours	470 miles
2 hours	1,200 miles
3½ hours	3,200 miles
4 hours	4,000 miles
7 hours	7,700 miles
24 hours	22,300 miles

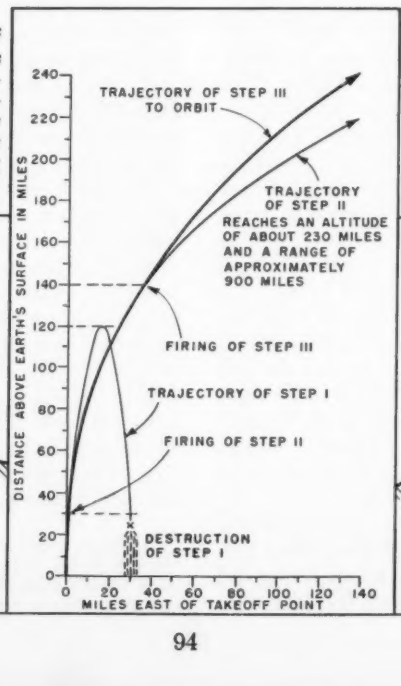
The last case would produce the interesting phenomenon that a rocket whose orbital plane coincides with the plane of the equator would seem to be motionless over one point of the equator; but it would probably be of little use otherwise. Even if this last case is ruled out, the choice of a useful orbit is still not a simple problem. The considerations influencing the choice are rather contradictory. Two factors speak in favor of a high orbit. Instruments in the rocket are intended to increase knowledge of conditions in interplanetary space, and since conditions will be more "pure" the farther the instruments are from earth, we have one factor favoring a high orbit. The other is that a rocket could be observed, both visually and by radar simultaneously, from a larger area the farther it is from the earth. A rocket in a 470-mile orbit, moving in the plane of the equator, could not be observed at all from any point in the United States because the bulk of the earth itself interferes with the line of sight.

The factors in favor of a low orbit are mostly of a practical nature. A low orbit is easier to establish. The angular movement of the rocket would be higher which would be very useful for navigational purposes and measurements generally. Finally – and this may be decisive – the range of the telemetered instruments may be insufficient for a high orbit. The difficulty of observing a rocket in a low orbit can be circumvented by making the plane of its orbit deviate appreciably from the plane of the equator. If, for example, the plane of the rocket's orbit were tilted 40 degrees to the plane of the equator, the rocket would be almost vertically over New York City from time to time and could still be checked by observation posts all along the Canadian border.

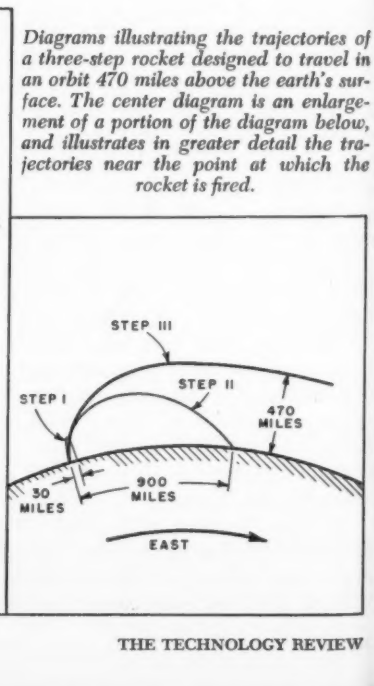
Placed in such an orbit the rocket would, in time, pass vertically over any point between 40 degrees northern and 40 degrees southern latitude. Because its period of revolution is far different from the period of diurnal rotation of the earth, the path of such a

All objects are subjected to the force of gravitational attraction and, at the earth's surface fall 16 feet per second per second. But, as shown below, of two projectiles fired horizontally, that with the greater muzzle velocity will have the greater altitude at any instant during flight, as the right-hand path illustrates.





Diagrams illustrating the trajectories of a three-step rocket designed to travel in an orbit 470 miles above the earth's surface. The center diagram is an enlargement of a portion of the diagram below, and illustrates in greater detail the trajectories near the point at which the rocket is fired.



rocket, projected on a Mercator map, would be a zigzag line with 40 degrees north and south as the limiting points. Merely by its existence, such a satellite rocket would produce a useful fix for navigational purposes. The fact that it moves fast is most useful for some purposes. The satellite will move through almost four degrees of arc in one minute of time so that the measurements checked at frequent intervals would show significant changes. This might prove especially useful for long-range missiles of the cruising type which are actually unmanned airplanes of one type or another. Human navigators can work satisfactorily with natural celestial bodies, but a robot navigator will probably need additional aids, such as a radar echo bounced off the satellite rocket for example.

A suitably built satellite rocket could be used to provide a wealth of scientific data. Such a rocket could obtain a complete solar spectrum continuously, except when it is in the earth's shadow. The visual brightness of the rocket might provide a clue to the density of cosmic dust. If we imagine that the rocket leaves the earth with a polished hull, its specular reflection should be gradually converted to spread – and even ultimately to diffuse – reflection by the impact of tiny cosmic particles with a corresponding change in its visual brightness. As the reflectance of the rocket diminishes, its temperature must increase because more solar radiation will be absorbed and less of it reflected back into space. From the reduction of visual brightness, observed directly, and the increase in temperature, reported by the instruments, the probable number of cosmic particles could be established within reasonable limits. Provided that enough power is available, the rocket might even transmit a television picture of the earth which should enable meteorologists to judge general meteorological conditions over most of the planet. Whether the satellite rocket could also replace the Iceberg Patrol in this manner would depend solely on the resolving power of its instruments. At present this appears doubtful but not impossible. In short, the satellite rocket would be a research instrument of the highest value and of unique opportunities.

Naturally there are quite a number of problems still to be solved before one could begin the design of such a satellite rocket. One is the means by which power is to be provided for operating the instruments. Batteries, as used in other research rockets, would be useless because they would provide power for only a few hours, whereas the main value of the satellite rocket lies in its permanence. Aside from the unlikely possibility that somebody may invent a novel method of storing electric energy which will support a small drain for years, there are mainly two possibilities deserving of some thought. One is based on the fact that, at any given moment, the sunward side of the rocket will necessarily be warmer than the other side, and also warmer than its interior. This fact may make possible the application of thermoelements as a source of power. If, as now seems likely, such thermoelements should be either too low in energy conversion or too heavy, or both, one might think of a small nuclear reactor as a power source. Since it might not need any shielding, such a reactor could be made relatively light and small in size. And it should produce enough power to energize all the instruments that could possibly be crammed into a fairly small rocket.

So far the discussion has been about the theoretical background of the whole subject and about the results which could probably be obtained. Now let us look at the engineering requirements of the rocket itself, restricting ourselves to one particular orbit, the 470-mile orbit with a period of revolution of about 100 minutes. The orbital velocity which the rocket would have to have for this case amounts to 4.6 miles per second. In order to become a satellite, the rocket must first of all be able to reach the 470-mile altitude, at which it must attain a horizontal velocity of 4.6 miles per second. Is such a feat possible? Part of the answer is to be found in earlier rocket flights.

The largest rocket which has performed satisfactorily is still the ex-German *V-2* which has reached a maximum altitude of 118 miles and a maximum velocity of almost precisely one mile per second. This rocket weighs roughly three metric tons when empty, carries a one-ton war head (which would become an instrument chamber in the orbital rocket) and can hold eight tons of fuel, consisting of liquid oxygen and ethyl alcohol with an admixture of 25 per cent of water by volume. The take-off weight, therefore, is 12 tons, while the weight after all fuel is consumed is four tons, and is made up of empty rocket and instrument container. Because the mass ratio is the total take-off mass divided by mass remaining after fuel consumption, rocket designers say that such a rocket has a mass ratio of 3 to 1. Theoretically a rocket with a mass ratio of 2.7 to 1 (more precisely $e : 1$) will attain a final velocity, v, which is equal to its exhaust velocity v_e. If we call the take-off mass M_o and the remaining mass (which includes the pay load) M_1 we can express this relation very simply as

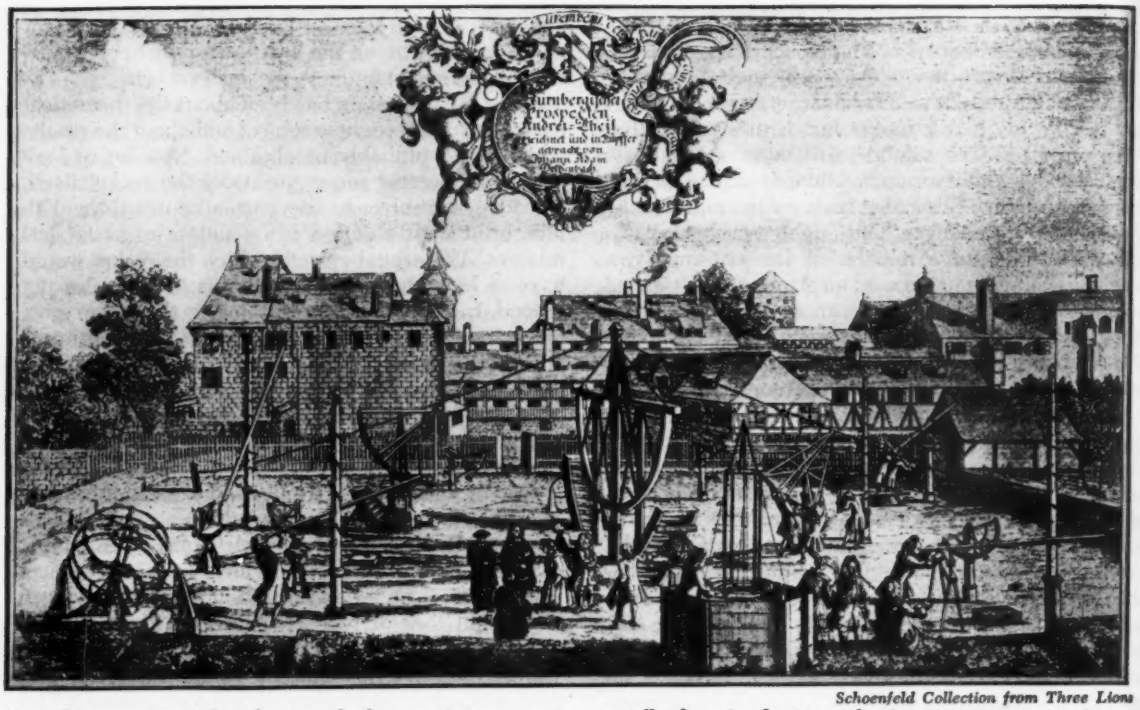
$$v = v_e \text{ when } M_o/M_1 = e$$

It must be remembered, however, that this formula is strictly valid only in empty space where there is no air resistance and a gravitational field of such small force as to be negligible.

The exhaust velocity of the *V-2* motor amounts to a little more than 7,000 feet per second. Consequently, if the relations given above were valid on the earth's surface, the *V-2* rocket should attain a velocity of 7,000 feet per second even if its mass-ratio were only 2.7 to 1. The mass ratio of the *V-2* is close to 3 to 1, but its maximum velocity, as has been mentioned, is about one mile per second instead of the theoretical mile and a third. The difference is caused, in part, by air resistance but the greatest discrepancy results from the need for the rocket to overcome the force exerted on it by the earth's gravitational field. If we expect a single rocket to assume an orbit around earth, we shall need either a much higher exhaust velocity or a much higher mass ratio; in all probability both would become necessary. With equal probability it now appears that neither figure would be attainable in reality.

The way out of this dilemma was demonstrated on the White Sands Proving Ground in New Mexico on February 24, 1949 when a *V-2* rocket took off, carry-

(*Continued on page 112*)



Schoenfeld Collection from Three Lions

Since the invention of the telescope, the history of astronomy is essentially that of reflecting and refracting instruments of constantly increasing size. In contrast to present-day giants for astronomical observation, the illustration above shows a view of the observatory at Nuremberg in 1472, erected by the astronomer and mathematician, Regiomontanus, maker of astronomical instruments. Certainly one of the oldest, if not the first observatory of modern times in Europe, this observatory antedates the invention of the telescope by about 135 years.

Giant Follows Giant

A 120-inch Pyrex Disk, Leftover from the 200-inch Mount Palomar Instrument, Will Become a Telescope in Its Own Right

By DAVID O. WOODBURY

GIGANTISM is no longer news in astronomy, now that the great Palomar telescope has settled down to its life work. But there is an interesting footnote to the Palomar story. Metaphorically speaking, it has begotten a second instrument, like itself a giant. A disk of glass, 120 inches in diameter, originally designed to test the big fellow, is to become a telescope in its own right, after lying unused for 16 years. It will be the second largest instrument in the world when completed.

The new Pyrex disk, actually older by some months than the 200-inch, has been sold to the University of California and will presently go to work at the famous Lick Observatory on Mount Hamilton. The knowledge and experience gained in 21 years of pioneer work on the 200-inch will be fully shared with the designers of the new instrument, saving much time and expense, and eliminating much uncertainty.

The long saga of the Palomar project began, in 1928, with a series of discouraging experiments with fused quartz. When this material proved unworkable in large masses, the Palomar designers turned to Pyrex glass as a second choice, but with misgivings. Since it was doubtful whether huge sizes could be cast without cracking, they asked the Corning Glass Works to begin modestly, with disks a few feet in diameter, and work up to a casting suitable for the 200-inch reflector. If successful, the smaller disks could be used as auxiliaries in the 200-inch telescope. They were completely satisfactory and were eventually ground and polished to fit into the Cassegrain and coudé systems on the instrument. All were thus used except the largest, the 10-foot disk, which weighed more than four tons.

But the 120-inch was no orphan. It was intended to be used for the vital but short-lived duty of making the final laboratory tests on the paraboloidal surface of the 200-inch mirror. For this service it was to be ground and polished optically flat, and by an ingenious arrangement of a point light source and auxiliary mirrors, would provide the collimated, or parallel, beams of light essential to test the parabolic form of its big brother. This man-made point source of light was the best substitute that suggested itself for an actual star at infinity; the astronomical source was impracticable because the 15-ton disk was to be figured two days' journey away from Palomar Mountain.

The preparation of the 120-inch optical flat, it was admitted, would be no simple matter. It must have its

own grinding machine; it must then wait until the big fellow was ground and semipolished to a true spherical surface, whereupon the main glass could be used as a testing instrument to determine perfect flatness of its smaller brother. This would be an elaborate and time-consuming job.

Soon after the disks arrived at the optical laboratory in Pasadena, the designers began to wonder if there were not some simpler way to achieve and test the 200-inch paraboloid. After extended calculations, the easier solution was found, in which a special lens, the usual Foucault pin-point light source and knife edge were employed. The lens was made and the test eventually set up and used with success. To verify results obtained from this test, a second method, using the Hartmann statistical sampling scheme, was introduced. The big mirror finally went to Palomar, leaving the 120-inch behind, an orphan after all. Its sale recently fills in a gap that would otherwise have had to be chalked up to experimental overhead.

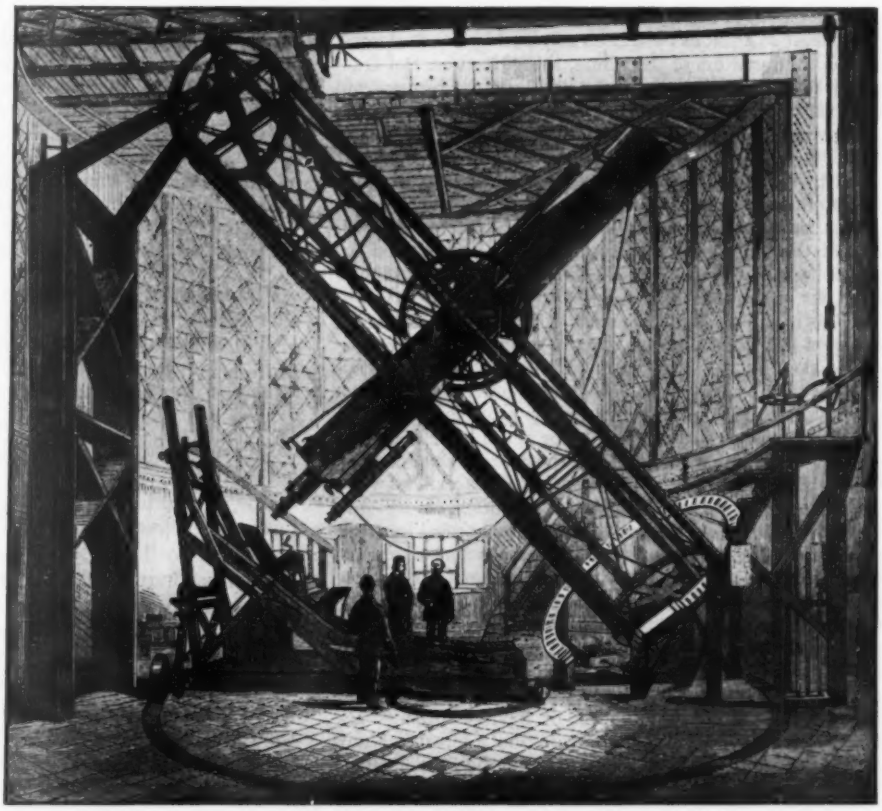
Today, everything that was learned on the Palomar job will be used to advance the telescope-making art in building the Mount Hamilton instrument. Most important will be the location of the optical shop in the basement of the observatory itself. This will mean that in the final stages of parabolizing the glass, when but millionths of an inch of material must come off, the mirror can be hoisted into its telescope mounting in a few hours and tested directly on stars.

A second advance will be that in the earlier stages of shaping, optical tests will be made on the glass without changing its position as it lies flat in the grinder. A hatchway will be provided in the observatory floor and the Foucault instruments will be installed high in the dome on the overhead crane, the testing axis being vertical. The importance of such vertical testing was realized very early in the work on the 200-inch mirror, which had to be stood on edge and held that way, while Foucault readings were taken along a horizontal axis. The result was that small displacements of the surface, introduced by gravity and the complication of the supporting mechanisms, influenced the test data making their evaluation very difficult. The improved technique, alone, should save much time and worry.

A number of lesser advances will also be made. While the telescope will have a fork type of mount, it will employ the oil flotation bearings developed for the 200-inch. The telescope tube, also, will be a structural unit of similar design, arranged to distort under gravitational stresses without bending the optical axis. Most interesting will be the use of a man-carrying cylinder at the main focus in the mouth of the tube. There was plenty of room for this in the original giant. To avoid blanking out too large an amount of starlight the tube will revolve eccentrically about the optical axis of the smaller telescope.

Perhaps no branch of pure research is less competitive than astronomy. And in the present case the closest co-operation will be set up between Mount Hamilton and the Palomar-Mount Wilson groups. Although the two instruments will have nearly the same focal length and photographic speeds, and will do the same

(Concluded on page 110)



The equatorial telescope at the Royal Observatory at Greenwich, near London, represented another giant of astronomy. With its 12.5-inch objective, the telescope shown at the right was installed in 1862 and for many years was the largest refractor in England.

The Royal Observatory was founded in 1675 for the definite purpose of improvement of navigation. Sir Christopher Wren chose the site and designed the first buildings for which Charles II granted £500. Because of progressive deterioration in conditions for astronomical observations at Greenwich, the 274-year-old observatory was recently transferred to Sussex.

Since 1884, the Greenwich site has served as the reference meridian from which longitude is measured.

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THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Science and the Humanities

REPORTED last month in these columns was that portion of President Killian's annual report to the M.I.T. Corporation which dealt with a review of operations for the 1948–1949 year, and the statement of the Administration's policy on academic freedom. It was in the first part that President Killian called for a fusion of science and the humanities, and outlined his educational philosophy. This month it is The Review's pleasure to summarize the remainder of President Killian's report which deals with a survey of student life at M.I.T. and statistical data on Institute operations.

During the period covered by the report, significant progress was made in improving student-faculty relations and student environment. Participation in student athletics increased markedly during the year and, to a much greater extent than was possible under more or less wartime conditions, students assumed increased responsibility in administering undergraduate activities at M.I.T. Speaking of these matters, President Killian said:

One of the striking aspects of student life at Technology is the high degree of responsibility accepted by our students for the conduct of their own affairs. With the hearty encouragement of the Office of the Dean of Students, even greater responsibilities have been assumed by the students, especially in matters of discipline, the government of fraternities and other housing units, and the improvement of our living environment. One aspect of this achievement was given national recognition during the year when the M.I.T. Interfraternity Conference was awarded the National Interfraternity Conference Trophy for contributing most to the life of its parent institution.

This past year over 2,200 undergraduates, or 60 per cent of the undergraduate student body, participated in intercollegiate and intramural sports. During the past two years we have been able greatly to extend our athletic facilities by the addition of nearly 400,000 feet of playing space on the West Campus, by the erection of the Rockwell Cage, by the renovation of the Walker Memorial Gymnasium, by the addition of eight new tennis courts provided by the Alumni Fund, by the provision of a new baseball diamond and new lights for field illumination for evening sports practice, and by the provision of a full-time athletic director and additional coaches.

Another example of the healthy condition of our student life at the Institute is the development of closer student-faculty relations and the creation of better opportunities for the two groups to work together for common educational goals. For many years our Student-Faculty Committee served mostly as a mechanism for handling student complaints. In the last two years, this committee has turned its attention to a constructive consideration of educational problems, and we now find ourselves in the interesting and happy situation of having students actively working with the Faculty in the interests of our teaching program. During the past year, the Student-Faculty Committee sponsored a series of open forums on the art of teaching, which were well attended both by students and by staff. At the opening of school this fall, this same committee sponsored a series of lectures for new instructors on the techniques of teaching.

Some time ago the Student-Faculty Committee proposed to the Institute that we set aside a pleasant and comfortably furnished room where students and faculty members can come together informally, and I am glad to report that we have been able to provide the space to make this room available.

The most significant improvement in our student environment during the year was the completion of the New Dormitory (The Review, **51**:25, 230, 282, 573, 575), now housing over 350 students. I hope that the fresh and forward-looking design of this great new housing unit has set the standard for additional dormitories at the Institute, all designed to promote friendly and responsible community living. We need additional living facilities to take care of at least a thousand more students on the Institute's campus, and the fulfillment of this need should have high priority in the months ahead. We need especially to replace the temporary barracks, now housing over 400 students.

Last spring we reorganized our dormitory and restaurant management under a Director of Housing and Dining Facilities (The Review, **51**:576). Frank M. Baldwin, who was appointed to this new post, will supervise our increasing facilities for student housing and dining services, to assure effective centralized direction. These services are now valued at over $5,000,000, and have an annual operating budget of more than $1,500,000. His duties include administration of all undergraduate dormitories, the Senior House, Walker Memorial, the Graduate House, and the Women's Dormitory, as well as our housing project for married students, Westgate and Westgate West. Broad policy relating to all housing will be determined by an Advisory Committee, which replaces the former Dormitory Board and which includes the Dean of Students, the Dean of the Graduate School, the Treasurer and Assistant Treasurer, and two members of the Faculty.

The major administrative change during the year, covered by President Killian's report, was the creation of the senior administrative post of provost, to which Professor Julius A. Stratton, '23, was appointed, as recorded in The Review (**51**:516). The primary concern of the provost is the administration and co-ordination of educational and research activities which do not fall within the jurisdiction of any single School, including the interdepartmental laboratories and the research projects of the Division of Industrial Coöperation. Also during the year there was created the Academic Council, charged with the responsibility of the executive co-ordination of the Institute's educational activities and of the administration of educational policy as determined by the Faculty.

Statistics of the Year. Financial statistics for Institute operations for the year 1948–1949 are covered in the report of Horace S. Ford, Treasurer, which is summarized separately on page 101 under the heading "Institute Finances."

Student enrollment continues at a high level, and although the postwar peak appears to have been passed, the Institute is still not able to accept all who apply for admission. This makes possible the maintenance of high standards through selection of the most promising students.

The total student body reached 5,433 in 1948–1949 compared with 5,662 in 1947–1948. As of September 21, enrollment for the present year reached 5,408. The enrollment of war veterans dropped from 54 per cent of the total student body in 1947–1948 to 48 per cent last year; during both years, 22 per cent were married. Included in the student body were 68 women. A total of 233 colleges and universities in the United States and 93 foreign educational institutions were represented. With 382 students from 60 foreign countries and comprising 7.1 per cent of the total enrollment, the Institute had the highest percentage of foreign students of any college in the country. There has been some decrease in the number of applicants for admission to the Freshman Class, as had been anticipated, but the number of applications for the Graduate School is still increasing.

More students received loans and part-time work last year than in the 1947–1948 school year. On the subject of student aid, the President's report states:

The demands on the undergraduate scholarship funds and the Technology Loan Fund were greater this year than in 1947–1948 because of changes in general financial conditions and fewer students studying under the G.I. Bill. There were 394 undergraduate scholarships granted, totaling $89,914. Ninety-eight students received loans totaling $46,600. The total number of loans and scholarships was 463 and the total amount was $136,514. Some undergraduates held both scholarships and loans. Eighty-seven men received loans as of June, 1949, bringing the cumulative total from 2,729 (June, 1948) to 2,816 men. This group of 87 men were loaned $61,050, bringing the cumulative total loaned from $1,980,610 (June, 1948) to $2,041,660 (June, 1949).

Total graduate scholarships and fellowships for 1947–1948 amounted to $176,880 and these scholarships and fellowships were granted to 233 recipients. This compares with a total of $142,702 distributed to 196 recipients in 1947–1948. This change was accounted for in large measure by the increase in the total number of industrial fellowships and a greater use of the funds available for graduate scholarships and fellowships. The number of fellowships sponsored by industrial companies totaled 85, with an aggregate stipend of $144,480.

The Student Employment Bureau placed 458 students in part-time jobs in 1948–1949, as compared with 391 in 1947–1948. The 1948–1949 group earned $98,657 as compared with $75,507 earned by the 1947–1948 group.

Personnel Changes. Most of the changes in personnel listed in the President's Report have been announced as they occurred throughout the year. The latest group of promotions and new appointments is included on page 101 of this issue. The Corporation ranks have been changed only by reason of term expirations during the past year. John M. Hancock has been elected to Special Term Membership, and, as already recorded in The Review (**51**:111, 283), Donald F. Carpenter, '22, has been elected to Life Membership, and Rudolf F. Haffenreffer, '95, Robert T. Haslam, '11, George J. Leness, '26, and Luis de Florez, '11, are new Alumni Term Members. C. Adrian Sawyer, Jr., '02, replaces C. George Dandrow, '22, as President of the M.I.T. Alumni Association.

Fabian Bachrach

Ralph Lowell

Corporation Term Member – 1949-1954

The election of Ralph Lowell, President and Chairman of the Board of the Boston Safe Deposit and Trust Company, to term membership for five years on the Corporation of M.I.T. has been announced by Dr. Killian, President of the Institute.

Mr. Lowell, who was graduated from Harvard University in 1912, has long been associated with the financial life of Boston. He is sole trustee of the Lowell Institute, of which the Lowell Institute School, conducted under the auspices of M.I.T., is one of many of its educational activities. He is also a trustee and director of many educational, philanthropical, and charitable organizations, including the Perkins Institute for the Blind, the Massachusetts General Hospital, the McLean Hospital, Vincent Hospital, and the Boston Museum of Fine Arts

But the dry, statistical records which are part of every annual report fail to bespeak the character of a corporate body. With this in mind, President Killian concluded his report in the following words:

One of the pronounced characteristics of M.I.T. is the unity of action made possible by the harmonious combination of Faculty members, officers of administration, members of the Corporation, students, and Alumni, which constitute our corporate body. This spirit of co-operation, combined with the superlative quality of our staff and students and the strength of this Corporation, underlies all the progress and forward-looking activities of the past year.

Progeny's Preference

INCLUDED among members of the first-year class at M.I.T. this fall are 35 freshmen whose paternal (and in one case both paternal and maternal) parents are

Technology Alumni. As was the case last year, the presence of one daughter in this group of 35 continues to prevent representation by sons only.

Registration for the Freshman Class in 1948 numbered 826 students – 49 of whom had alumni affiliations with M.I.T. The fall of 1949 shows a Freshman-Class count of 748, as of September 21, with the students listed below to share alumni activities in the future with their families. Although the 1949 Freshman-Class registration is about 10 per cent less than the 1948 figure, and the alumni-to-be group smaller this year by approximately 30 per cent over last year, the choice of M.I.T. by the group in the following list is indicative of a continued need for scientific and engineering training supplemented by studies in the humanities:

Student	*Parent*
Charles T. Abbott, Jr.	Charles T. Abbott, '30
Burton A. Babb	Maynard A. Babb, '28
Edward B. Beattie	Malcolm B. Beattie, '23
Bruce B. Beckley	Kenneth F. Beckley, '27
Robert H. Brown, Jr.	Robert H. Brown, '22
Charles D. Buntschuh	Henry C. Buntschuh, '28
Donald Carlson	Hilding N. Carlson, '13
Raymond A. Dietz	Walter Dietz, '23
Betty Ann Ferguson	William W. Ferguson, Jr., '26
Paul E. Gabrenas	Anthony P. Gabrenas, '26
James L. Gleason	Isaac W. Gleason, '26
John K. Glynn	John W. K. Glynn, '15
Standish C. Hartman, Jr.	Standish C. Hartman, '29
Edward S. Hickey	John J. Hickey, '16
John Hitchcock	Lauren B. Hitchcock, '20
Allan S. Hoffman	Saul A. Hoffman, '16
George W. Hooper	John R. Hooper, '27
James H. Howard, Jr.	James H. Howard, '25
Franklin M. Jarman	Walton M. Jarman, '25
William T. Kwan	Sung-Sing Kwan, '19
Nelson C. Lees	Malcolm B. Lees, '20 Cornelia N. Lees, '21
Clarence J. McDonough, 3d	Clarence J. McDonough, Jr., '25
Roger W. Maconi	Frank Maconi, '20
Frederick E. Mangelsdorf	Theodore A. Mangelsdorf, '26
Richard A. Neitlich	George Neitlich, '24
David A. Nelson	Dewey Nelson, '24
William B. Ryan	John F. Ryan, '22
Edward H. Schwarz	Edward R. Schwarz, '21
Henry S. Slayter, 3d	Rudolf S. Slayter, '28
Barry A. Stein	Hyman Stein, '30
Edgar L. Stolfer, Jr.	Edgar L. Stolfer, '29
Prasong Sukhum	Prasob Sukhum, '23
Christopher R. Whitcombe	Stanwood E. Whitcombe, '23
Ralph E. Wilbur	Harland A. Wilbur, '22
Stetson C. Winkfield	Holley S. Winkfield, '19

Addison F. Holmes: 1882–1949

THE death of Addison F. Holmes, '04, Emeritus Associate Professor of Applied Mechanics, at his home in Winchester, Mass., on November 5, marked the passing of an able teacher widely known to generations of Technology students.

Professor Holmes was born in Newton Upper Falls on September 16, 1882, and prepared for M.I.T. at the Mechanics Arts High School. He was graduated from the Institute in 1904 and immediately joined the staff as an assistant in the Department of Mechanical Engineering. In 1906 he became an instructor, and in 1919 he was promoted to the rank of assistant professor of theoretical and applied mechanics. He was advanced to associate professor of applied mechanics in 1925. Professor Holmes was retired with the rank of emeritus associate professor in 1948 and was appointed honorary lecturer. He continued his duties on the staff until a few days before his death from a heart ailment from which he had suffered for several years.

During World War I, Professor Holmes served as a major in the Army Ordnance Corps, and carried on special work for the Army at the Institute. He was a member of the Institute's teaching staff for 45 years, and conducted his duties in a quiet unassuming manner which won him many friends among his teaching colleagues and the numerous students who entered his classes. He was a member of the American Society for Testing Materials, American Association of University Professors, Scabbard and Blade, and the Army Ordnance Association. He was also author of articles on concrete.

Professor Holmes is survived by his wife, Stella G. Holmes. Funeral services were held in Winchester on Tuesday, November 8.

Robert Astra, '52; The Tech

Friendliness pervaded when the Honorable Pandit Jawaharlal Nehru, Prime Minister of India (left foreground) *and his sister, Mrs. Vijaya Lakshmi Pandit, Indian Ambassador to the United States* (center) *were greeted by Dr. Killian* (right) *at a reception and tea on October 21 at the President's House. Interest in the Nehrus' visit was enthusiastically expressed as shown by the attendance of members of the Hindustan Students' Association of Greater Boston – some of whom appear in the background of the above photograph.*

Institute Finances

IN the annual Treasurer's Report, presented to the Corporation on October 3, Horace S. Ford and Joseph J. Snyder, 2–44, Treasurer and Assistant Treasurer of the Institute, respectively, reported that M.I.T.'s endowment and other funds now possess a total book value of $47,200,000 invested in securities, with a market value of $50,200,000. Plant assets are approximately $2,654,000 above last year – standing at $22,243,000. Of this amount, $1,951,000 has been applied toward the construction of the Charles Hayden Memorial Library; $70,000 for additions to the Sloan Automotive Laboratories; $157,000 for the construction of the laboratory for the 12,000,000 electron-volt generator; $217,000 to complete the Rockwell Athletic Cage; and $175,000 has been set up as the book value of the Round Hill property at Dartmouth, Mass. The yield on investments based on book values increased somewhat over the previous year with the allocation to funds, however, at the previous rate of 4 per cent.

Operations totaled $23,353,000 for the 1948–1949 year, representing an increase of $2,300,000 over the previous year. Income and expense were distributed as shown in the accompanying flow chart. The following comparative percentage of distribution of the major elements of income and expense, during selected years for the past decade, shows the marked effects of sponsored research on the Institute's fiscal operations. Of special significance in these tables is the low percentage of total expenditures now required for plant operation and general administrative expenses.

Distribution of Major Elements of Income and Expense

1939–1940, 1947–1948, 1948–1949

Income

	Per Cent		
	1939–1940	*1947–1948*	*1948–1949*
Tuition	48	20	16
Investments	32	6	6
Gifts and Other Funds	7	8	9
Research Contracts:			
For Direct Expense	3	55	58
For Indirect Expense	0	5	6
Dormitories, Dining Services	10	6	5
	100	100	100

Expense

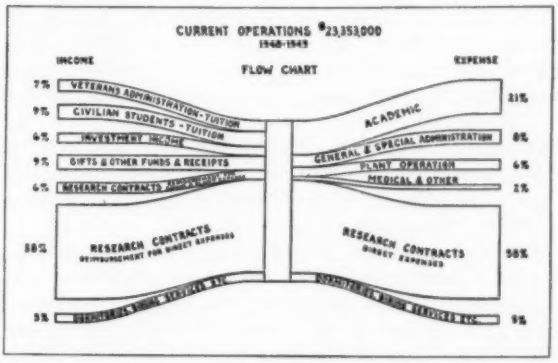
	1939–1940	*1947–1948*	*1948–1949*
Academic	61	24	21
General Administrative	13	7	8
Plant Operation	10	6	6
Research Contracts:			
Direct	3	55	58
Medical and Other	4	2	2
Dormitories, Dining Services	9	6	5
	100	100	100

The year 1948–1949 ended with a $231,736 deficit as a direct result of salary increases which went into effect during the year; it was felt that the increase was so essential that the Institute could properly incur a deficit this year. The increase in tuition (from $700 to $800 per academic year) which was announced a year ago took effect with the opening of school in September, 1949, and will go part way in helping the Institute to balance its budget. It is interesting to observe that the income from tuition has, throughout the years, almost always been equal to academic salaries, with income from investments and other sources carrying plant operation, administration, and related expenses.

Total gifts received each year since 1940 are shown in the following table:

	Capital Additions	*Total Gifts*
1940–1941	$ 511,949	$ 888,180
1941–1942	534,316	926,897
1942–1943	616,702	884,268
1943–1944	1,132,835	1,367,507
1944–1945	1,245,911	1,736,892
1945–1946	2,042,533	2,549,969
1946–1947	1,945,297	2,382,681
1947–1948	1,381,329	2,191,822
1948–1949	1,900,737	2,536,802

The total of gifts shown for 1948–1949 does not include pledges to the Development Program received during the year. As the M.I.T. Development Program moves forward, the additional funds will aid in stabilizing the Institute's finances while simultaneously providing better facilities for education and student living at M.I.T. One of the most heartening parts of the current trend in gifts to the Institute is the steady increase in support from industrial corporations. Nearly a quarter of the gifts received by the Institute last year came from industrial companies.



Readers of The Review will be especially interested to know that for the period covered in this report contributions to the Alumni Fund totaled $152,502 from 9,963 Alumni. This brings the total contributions to $1,209,639 for the nine-year period during which the Alumni Fund has been operating.

Faculty Family

THE fall of 1949 witnessed 41 promotions and new appointments on the Faculty and staff of M.I.T. To hold the rank of full professor are four: Robert R. Shrock, acting in charge of the Department of Geology; Major Thomas U. Lineham, Jr., Department of Military Science and Tactics; Captain Guy Chadwick, Department of Naval Architecture and Marine Engi-

M.I.T. Photos

Photographed above, reading from left to right, are: Robert R. Shrock, Professor of Geology, acting in charge of the Department; Major Thomas U. Lineham, Jr., Professor of Air Science and Tactics; Captain Guy Chadwick, Professor of Naval Engineering; and Captain James M. Farrin, Jr., '34, Professor of Naval Construction.

neering; and Captain James M. Farrin, Jr., '34, also of the Department of Naval Architecture and Marine Engineering.

Dr. Shrock, Professor of Geology, joined the Faculty at M.I.T. in 1937 as an assistant professor. He was promoted to the rank of associate professor in 1943, and from 1946 until 1949 has been an executive officer in the Department of Geology. Indiana University granted an A.B. degree to Professor Shrock in 1925, a master's in 1926, and in 1928, the degree of doctor of philosophy. Dr. Shrock taught geology at the University of Wisconsin from 1928 until 1937 when he came to the Institute.

Major Lineham, Professor of Air Science and Tactics, came to the Institute in September, 1948, as an assistant professor. He is a graduate of Bowdoin College and received an A.B. degree from that Maine institution in 1940. Major Lineham was an instructor in applied Air Force communications in the Air Force Special Staff School, Air University, Montgomery, Ala., for three years, and during World War II served for 30 months in the Southwest Pacific as communications officer with various units.

Recently the planning officer at Boston Naval Shipyard, Captain Chadwick was graduated from the United States Naval Academy in 1920, and received an M.S. degree in 1927 from Columbia University. Following duty as a general line officer in the Navy, he was placed in charge of designing machinery for a number of naval vessels in 1937, including the *U.S.S. Franklin D. Roosevelt*. Captain Chadwick is now professor of naval engineering at M.I.T.

Captain Farrin, who becomes Professor of Naval Construction at M.I.T., was head of the Preliminary Design Branch of the United States Navy Bureau of Ships in Washington, D.C., until his new assignment at M.I.T. He was graduated from Annapolis in 1929 and received his S.M. degree from the Institute in 1934.

Added to the list of associate professors at the Institute are: Alexander Bavelas, '48, and Max F. Millikan, both of the Department of Economics and Social Science; William A. Wilson, Department of Mechanical Engineering; Lieutenant Colonel Burton B. Bruce, '38, Lieutenant Colonel John W. Fitzpatrick, and Captain Jack W. Streeton, all of the Department of Military Science and Tactics; J. Whitney Perry, '31, Department of Modern Languages.

Welcomed to the rank of assistant professor are: Warren L. Towle, '34, Department of Chemical Engineering; Robert Solow, Department of Economics and Social Science; Thomas F. Jones, Jr., '40, Department of Electrical Engineering; William C. Bauer, '41, Department of Food Technology; Norman C. Dahl, '50, and Frank A. McClintock, '42, both of the Department of Mechanical Engineering; Harry Udin, '37, Department of Metallurgy; Captain Philip B. Anderson, Department of Military Science and Tactics; Martin A. Abkowitz, '40, Department of Naval Architecture and Marine Engineering.

Now joining the Institute's staff as instructors are: Delvin E. Kendall, Jr., '45, Department of Aeronautical Engineering; Robert Newman, School of Architecture; Robert G. James, Department of Business and Engineering Administration; Charles K. Leeper, '48, Edward A. Mason, '48, Richard C. Ross, and Charles W. Shipman, '48, all of the Department of Chemical Engineering; George L. Zimmerman, Department of Chemistry; Raymond Dennett, Roy Olton, and Herman T. Skofield, Department of Economics and Social Science; Ralph J. Kochenburger, '40, and John H. Van Os, Department of Electrical Engineering; Robert L. Koehl, Department of English and History; William H. Dennen, '42, Department of Geology; James B. Reswick, '43, Department of Mechanical Engineering; Frederick H. Buttner, '49, Karol J. Krystyan, James E. Reynolds, and James Wong, '48, all of the Department of Metallurgy.

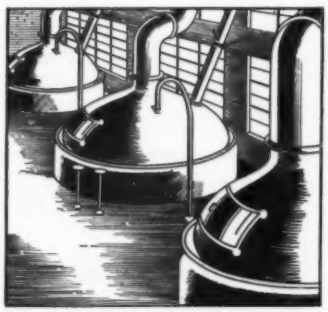
Carl B. Allendoerfer, professor of mathematics at Haverford College, has been appointed visiting professor of mathematics at M.I.T. for six months, beginning in February, 1950. At Haverford since 1938, Dr. Allendoerfer was recently on leave at the Institute for Advanced Study in Princeton, N.J. His research and publications have been in the field of differential geometry and the connections between differential geometry and topology.

(*Continued on page 104*)

BUSINESS IN MOTION

To our Colleagues in American Business . . .

The brewing industry has been in an expansion and modernization stage since the end of the war made copper freely available to it once more. New breweries are being built, and older ones enlarged, in order to meet the increasing demands of the public. As a result, the coppersmiths who fabricate brewing equipment have given Revere large orders for copper sheet and copper tube, which they turn into such items as brew kettles, mash tubs, lauter tubs, wort tanks, cookers, water heaters, and piping. Because the brewing of beer is necessarily done on a large-volume basis, the equipment is correspondingly huge. Orders for several hundred thousand pounds of copper are not unusual.



Though the brewing people thus are large users of Revere copper, they are not direct customers; the Revere customer is the coppersmith who fabricates to brewers' specifications. Nevertheless, Revere keeps a friendly hand outstretched to the brewer. Lately we have talked with quite a few brewmasters, and have found the same outstanding loyalty to copper that existed before the war and which has, in fact, been a feature of the brewing industry from its beginnings centuries ago. One master brewer, for example, said: "In planning the mammoth new installations for our $12,500,000 expansion program, copper was chosen because it is the most ductile metal for the fabrication of specially-designed brew kettles and related equipment; in keeping with time-honored traditions."

Brewing is, in fact, a remarkable mixture of tradition and science. Beer and ale are among the oldest of man's beverages, and all the evidence indicates that copper, probably man's first metal, has been used since the beginning. This ancient art relied upon the rule of thumb, experience, for centuries. It is now under a large measure of scientific control as well, the brewmasters' high talents being supported and confirmed by laboratory checks of materials. It is therefore especially gratifying to Revere that copper continues to be the metal preferred by brewers.

There is an old saying: "Be not the first by whom the new is tried, nor yet the last to cast the old aside." What is important, however, is not newness and not oldness, but suitability. A material may be new as tomorrow's sunrise, yet suitable for only a few applications. It is part of every manufacturer's task to study the old as well as the new, and be certain he is neither unreasonably wedded to tradition, nor unwisely eager to change for the sake of change. In making such studies he can and should call upon his suppliers, who, like Revere, are always glad to provide the latest and fullest information about their materials.

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Executive Offices:

230 Park Avenue, New York 17, N. Y.

THE INSTITUTE GAZETTE

(*Continued from page 102*)

New Alumni and Review Offices

SEPTEMBER 15 was moving day for the M.I.T. Alumni Association and its publication offshoot, The Technology Review. Visitors to the Institute who look for the Alumni and Review Offices at the old stand on the second floor of the Rogers Building will find that some space of the former occupant has now been converted into academic classrooms and that other areas are now used by the Industrial Liaison Office. Upon further journeyings, they will find Alumni activities now housed in new quarters on the second floor of Building 1, overlooking both Memorial Drive and Du Pont Court, in space formerly occupied by the Department of Economics and Social Science.

This move to new quarters was part of a broader plan of space redistribution to meet present needs of the Institute more satisfactorily. The change to new quarters in Building 1 was made possible when the Departments of Business and Engineering Administration and of Economics and Social Science moved into one wing of the new Charles Hayden Memorial Library last August.

Visitors to the Institute will find a cordial reception in Room 1–280 which is also the entrance to the offices of the Executive Vice-president and of the Secretary-Treasurer of the Alumni Association. The Alumni Office and Alumni Register are across the corridor in Room 1–275. Henry B. Kane, '24, as Director of the Alumni Fund, has his office in proximity with other offices in Room 1–272. The Technology Review occupies a suite of four rooms. Entrance to the Business Office is through Room 1–274, and to the Editorial Office through Room 1–281. A cordial welcome is extended to all readers of The Review to visit Alumni Association headquarters on their next visit to the Institute.

On the first floor of Building 1, space formerly occupied by the Department of Business and Engineering Administration has been remodeled and finished for the Alumni and Student Placement Office.

Kickoff

OPENING its 1949–1950 season, 128 members and guests attended the 270th meeting of the Alumni Council in the Graduate House on October 24. As President of the Alumni Association, C. Adrian Sawyer, Jr., '02, presided at this important business and social meeting at which announcement was first made of the formal opening of plans for general alumni participation in the program to raise $20,000,000 for the Institute by members of the Committee on Financing Development.

During the business portion of the meeting, new members of the Faculty, Class and Club Representa-

(*Continued on page 106*)

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How Edwin Peterson might answer his 7-year-old son Paul. Edwin knows the answers. He's been around Norton for 30 years. In fact, ten percent of Norton employees have been on the job 25 years or more.

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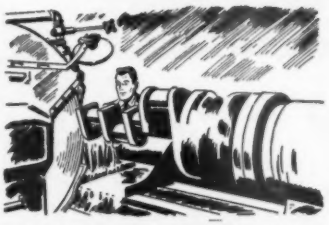
"To make traveling more fun. The idea is to give people more to see and do while riding faster and safer. That means more passengers for the railroads so that they can keep fares down and still add more comfort to long trips."



"Railroad comfort comes from many things, son. Smooth-fitting parts are important. Parts like Diesel engine crankshafts, pistons and wheels. That's why so many railroad shops use Norton grinders and Alundum grinding wheels to make parts smooth.

"Take those side rods on steam locomotives. They get farther over on the smooth side thanks to Norton internal grinding wheels. And parts are finished so accurately with Norton quality controlled wheels that they last for thousands of miles, Paul.

"Getting back to comfort . . . modern trains travel over 60 miles an hour. So, they need smooth rail joints. Those joints are welded for safety. Then, they're ground smooth and slotted with Norton grinding and cut-off wheels."

"Hundreds of other parts of modern railroad trains and tracks also get a lift from the sure touch of Norton Products. So does just about any other product you can name. That's why I'm not boasting when I say that Norton makes better products to make other products better."

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NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

THE INSTITUTE GAZETTE

(*Continued from page 104*)

tives, alternates, and guests were introduced; resolutions on the late Professor Harry M. Goodwin, '90, and George M. Thompson, '73, were read and adopted by a silent rising vote; the minutes of the last Council meeting on May 23 were approved; and reports – all of which were subsequently approved – were submitted by the secretary, the Committee on Audit and Budget, and the director of the Alumni Fund.

For H. E. Lobdell, '17, publisher of The Review, Donald P. Severance, '38, Secretary and Treasurer of the Alumni Association, reported that The Review had ended its last year's operation with an excess of income over expenditures amounting to $13,644, which amount has been turned over to the Alumni Association. Also reported was a loss of $2,365 on Alumni Day last June, an amount well within the budgeted loss of $2,500. Changes in class affiliation were approved for 16 Alumni. The secretary also reported that, between May 25 and October 20, alumni clubs in 17 cities as far as London, Seattle, and Mexico City had been visited by members of the Institute staff or the Alumni Council.

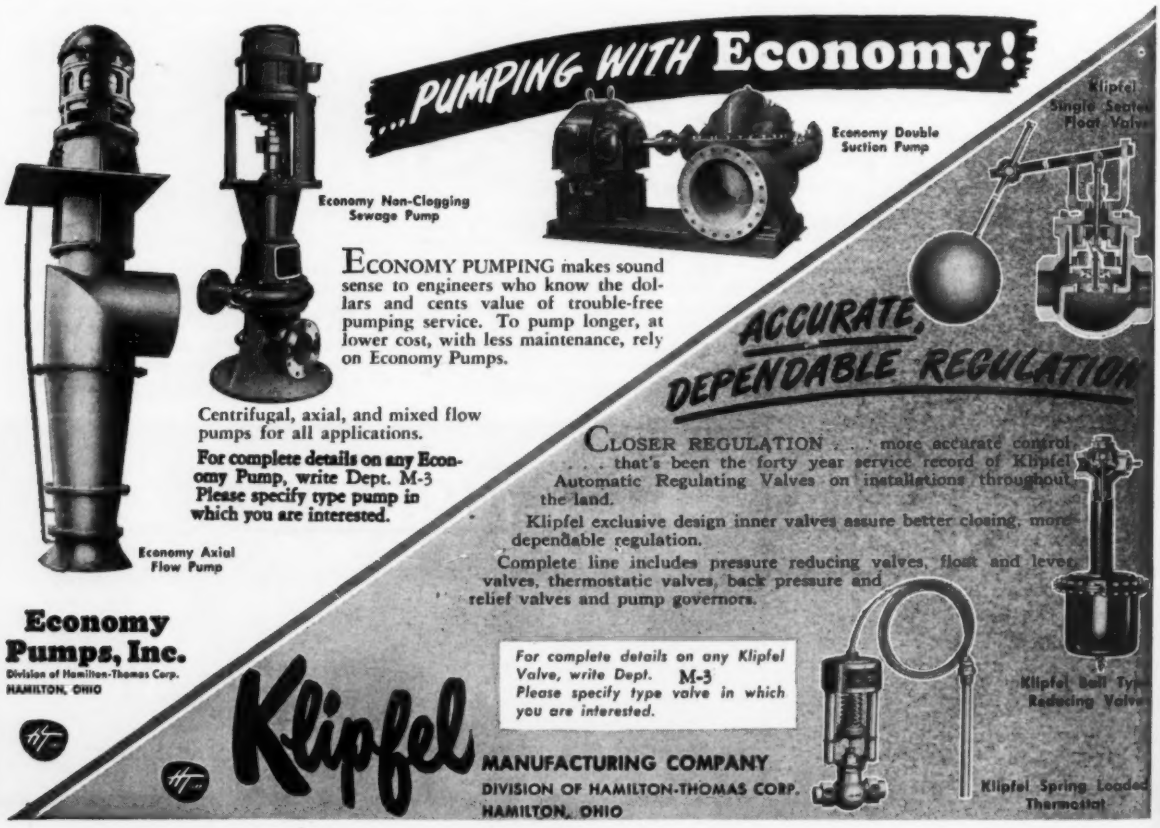
In preparation for Alumni Day, 1950, Hugh S. Ferguson, '23, was named general chairman, and Allen Latham, Jr., '30, was designated as deputy chairman of the Banquet Committee. In contrast to the Saturday Alumni Days which had become customary during the war years, it was also announced that Alumni Day, 1950, would be held on Monday, June 12, at the Copley Plaza Hotel in Boston.

Recognition was withdrawn from four alumni clubs (three of which were outside the United States) that had been inactive for a considerable length of time; but the M.I.T. Clubs of Arizona and of Fort Worth were added to the list of active clubs which now numbers 82.

Mr. Sawyer then called upon H. B. Richmond, '14, chairman, Committee on Alumni Participation, to review recent progress in the Institute's campaign to raise $20,000,000 for endowment and capital needs. Mr. Richmond announced that general alumni participation in the fund would be opened on January 1, and he outlined the opportunities which Alumni would have to participate in this program as individuals. To reach the goal of $20,000,000 for M.I.T. postwar development, it is necessary that approximately 50 per cent, or $10,000,000, be obtained from special gifts ranging in size from $100,000 upwards; that 30 per cent, or $6,000,000, must be raised from Alumni and friends who can make gifts in four and five figures; that 20 per cent, or $4,000,000, will be raised by general alumni giving. It was also announced that, for the year beginning January 1, 1950, the Alumni Fund would be merged with the greater effort of the Committee on Financing Development.

The second talk of the evening was made by Ralph

(*Continued on page 108*)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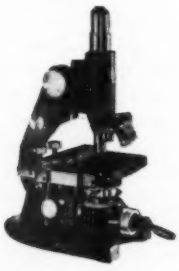

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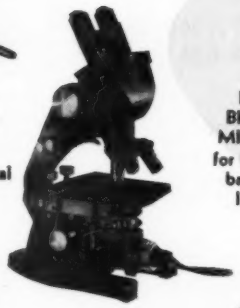

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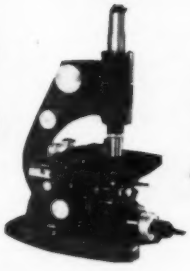

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Harold E. Koch '22 President

Elton E. Staples '26 District Mgr., Cleveland

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THE INSTITUTE GAZETTE

(*Continued from page 106*)

T. Jope, '28, Assistant Executive Director of the Committee on Financing Development. He outlined the organization which had been set up, showing by map those portions of the United States to be served by the seven regional offices of the Development Committee. These offices will begin functioning this fall with the co-operation of local Alumni.

As the concluding talk of the evening, President Killian was asked to acquaint Council members with significant events which had taken place at M.I.T. since the last Council meeting. Dr. Killian opened his remarks by stressing the active summer programs which had taken place at M.I.T. Under a grant from the Westinghouse Educational Foundation, 50 high-school teachers of science were enabled to take science refresher courses at M.I.T. during the summer. The student-managed Foreign Student Summer Program went into its second year by providing opportunity for 80 foreign students (mostly from Western Europe) to attend summer courses at the Institute at minimum cost. Two symposia, one on mathematical computation methods and the other on food technology, were organized for the benefit of engineers in industry and had been enthusiastically attended. Many members of the Faculty visited Europe and remote portions of the United States on business or pleasure trips. President Killian also reported that the supersonic wind tunnel was virtually completed and that inauguration ceremonies would probably be held in November. New construction, which is progressing rapidly, at the Institute includes the hydrodynamics towing tank, the 12-million electron volt electrostatic generator, and the Charles Hayden Memorial Library.

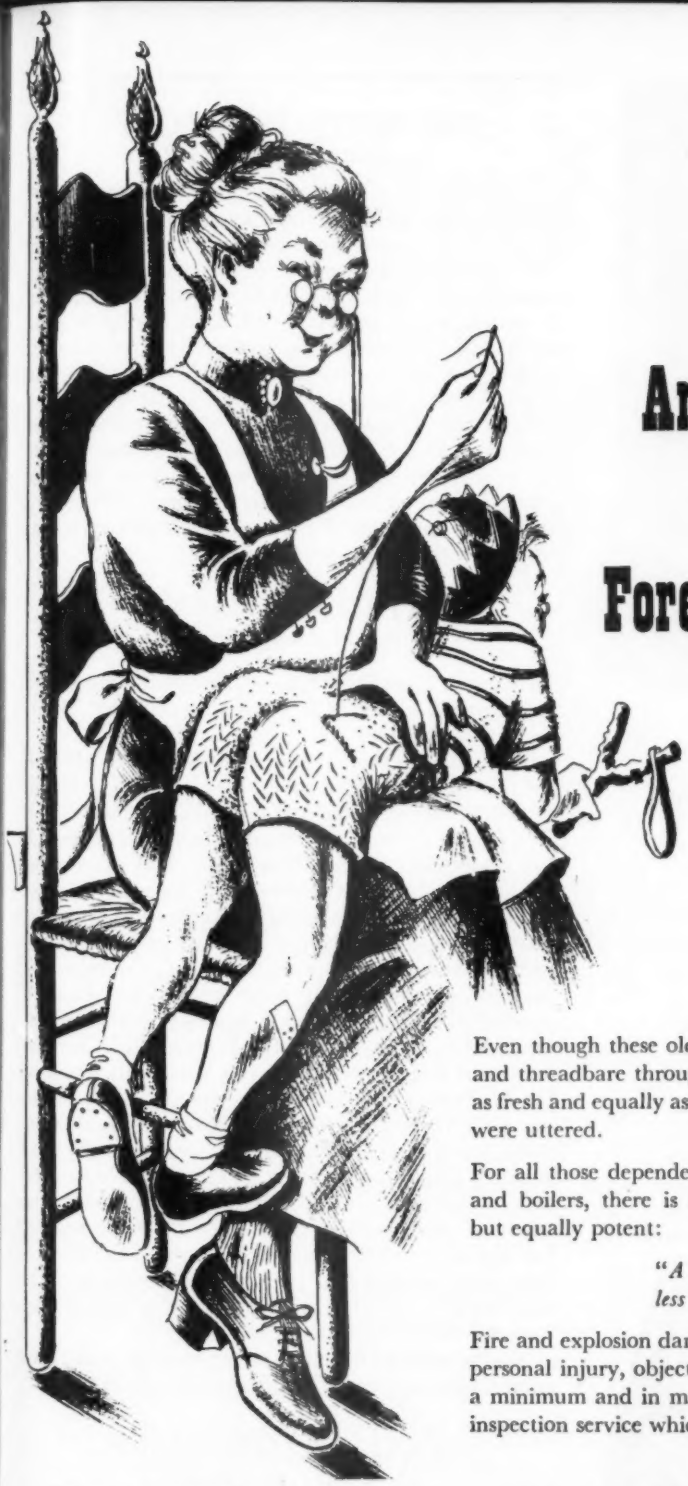
Sherlock for Insulin

DEVELOPMENT at M.I.T. of a quick and accurate test for insulin and a method which promises an important increase in production of this life-saving drug, both based on a process by which molecules of insulin can be made to virtually purify themselves has been announced by President Killian.

The process, developed by David F. Waugh, Associate Professor of Physical Biology at the Institute, in co-operation with the research laboratories of Armour and Company, constitutes the first known chemical test for active insulin. There is evidence, Dr. Waugh believes, that once we find out enough about them, we may be able to apply the same procedures of self-purification to other proteins.

The research which led Dr. Waugh to these advances began with a fundamental study of the structure of protein molecules, essential constituents of every living cell known to man. Dr. Waugh discovered that under certain conditions insulin molecules display a Scotch-like clannishness; they associate with each other to form tiny threadlike particles called fibrils. Such a fibril, invisible except with the aid of the electron microscope, may include up to 80,000 indi-

(*Concluded on page 110*)



A stitch in time

An ounce of prevention

Forewarned is forearmed

Even though these old proverbs may seem to have become worn thin and threadbare through frequent use, the truths they portray are just as fresh and equally as valid today, as the first day these gems of wisdom were uttered.

For all those dependent upon efficient operation of plant, machinery and boilers, there is another proverb — a little younger perhaps — but equally potent:

> "*A planned shut-down is usually far less costly than a forced shut-down.*"

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"Telltale" Lock Ring readily visible — shows joint is securely locked.

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THE INSTITUTE GAZETTE

(*Concluded from page* 108)

vidual molecules. In forming these fibrils, Dr. Waugh found, insulin molecules are highly selective. No other compound is permitted in this close association; impurities are locked out. Once formed, these fibrils of virtually pure insulin join with other similar threads to make weblike tangles like loose piles of jackstraws.

The production of insulin today requires a number of purification steps applied to an initial extract. At each of these steps accurate information about the amount of active insulin present is desirable. All of the time-consuming, tedious, and complex tests on animals – procedures requiring elaborate laboratory facilities – are replaced by Dr. Waugh's simple chemical test for the presence of insulin.

MYTHS OF AVIATION

(*Concluded from page* 92)

the ground. Daniel J. Maloney, the pilot, was killed. Some years later, in 1911, in a similar accident, Montgomery himself was killed.

Many explanations of the accidents were offered, but the Wrights, when they heard about the design of the Montgomery machine, formed an opinion which they passed on to their friend, Chanute, and which was doubtless correct. Montgomery had placed his wings one in front of the other, with the rear wing set at a larger angle of incidence than the forward one. That was especially dangerous on a cambered wing, because when the wings are cambered, the center of pressure, at most of the flying angles, travels rearward with decrease of angle, instead of forward, as supposed by Montgomery. The Wrights told Chanute, before the first accident occurred, that if any machine like Montgomery's were pointed steeply down, to attain a high speed and a small angle of attack, the machine would dive at a steeper and steeper angle until it would finally turn over on its back. The horizontal rudder (elevator) on the Montgomery machine was too small and too close to the planes to have enough turning force to bring the machine out of the dive. It was not surprising that both men who operated the machine were killed; the wonder was that a fatal accident did not occur at the first trial.

Montgomery's chief title to fame is the early date at which he developed enthusiasm for gliding.

GIANT FOLLOWS GIANT

(*Concluded from page* 97)

kind of extreme-distance work, there will be no duplication. The sky is so vast and the astronomer has as yet explored so tiny a part of it, that many lifetimes of research with both instruments will not reveal all that is hidden. The only regret is that cosmic studies in the Southern Hemisphere must continue at a slow rate because of inaccessibility and the prohibitive expense of establishing large observatories at the remote ends of the earth.

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THE SATELLITE ROCKET

(Continued from page 95)

ing a smaller rocket of the *WAC-Corporal* type as its pay load. The smaller rocket lifted out of the larger one just before the fuel supply of the larger one was exhausted. Then it added its own velocity of one half mile per second to the one mile per second of the *V-2*. The resultant velocity of one and a half miles per second carried the *WAC-Corporal* to an altitude of 250 miles, whereas the *V-2*, minus power and also minus pay load, rose only to about 100 miles. This method of using a small rocket as a pay load for a larger rocket is called the "step principle" and it is worth noting that a three-step rocket, with solid fuels, the *Rheinbote* or "Messenger from the Rhine," was used by the Germans during the last phases of World War II as a long-range weapon against Antwerp. So far no three-step rocket using liquid fuels has been built, but one may assume that the techniques worked out for the two-step system of the *V-2*-launched *WAC-Corporal* will work for a three-step rocket too.

All this leads to the conclusion that a three-step rocket will probably be needed to establish a small artificial satellite. On the basis of two assumptions, it is possible to calculate the behavior of a required three-step rocket. One of these is that the mass ratio of each of the three steps was the same, namely 3.5 to 1 which would result in a theoretical velocity of five fourths of the exhaust velocity. The other assumption is that the exhaust velocity was assumed to be 7,700 feet per second or about 10 per cent higher than that of the *V-2* motor. This means that each step, independently, would attain a theoretical velocity of 9,625 feet per second. The difference between this theoretical value and the probable actual performance was taken into account by making appropriate reductions* as follows:

Step I.

Theoretical velocity 9,625 ft/sec., minus 20 per cent reduction = 7,700 ft/sec.

Step II.

Theoretical velocity 9,625 ft/sec., minus 10 per cent reduction = 8,660 ft/sec.

Sum of probable actual velocities of Steps I and II = 16,360 ft/sec.

Step III.

Theoretical velocity 9,625 ft/sec., no reduction = 9,625 ft/sec.

Sum of probable actual velocities = 25,985 ft/sec.

Rounded off, this figure may be taken to be 26,000 feet per second. The velocity actually required in that orbit would be 24,300 feet per second, so that there is

(Continued on page 114)

* The reductions for the different steps are, of course, guesses, based on V-2 performance. In this example the first step is given the highest reduction because it rises essentially vertically and has to overcome air resistance. Step III is without reduction because it would accelerate essentially horizontally.

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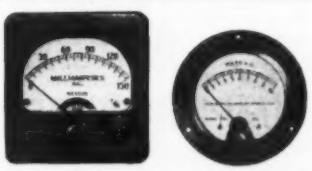

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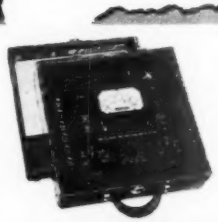
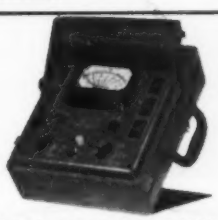
(Model 697) VOLT-OHM MILLIAMMETER one of a line of pocket-size meters, Model 697 combines a selection of AC and DC voltage, DC current, and resistance ranges. Ideal for maintenance testing and many inspection requirements.



(Model 785) INDUSTRIAL CIRCUIT TESTER a versatile, portable tester for laboratory or maintenance needs, where an ultra-sensitive instrument is required. Provides 27 AC and DC voltage, AC and DC current, and resistance ranges. (DC sensitivity 20,000 ohms per volt.)

(Model 779, Type 1) SUPER-SENSITIVE ANALYZER small, light, compact, 26 range Volt-Ohm-Milliammeter with 5 DC voltage ranges, sensitivity of 1000 or 20,000 ohms per volt. AC temperature compensated. Self-contained power supply. Ideal for many production and test requirements.



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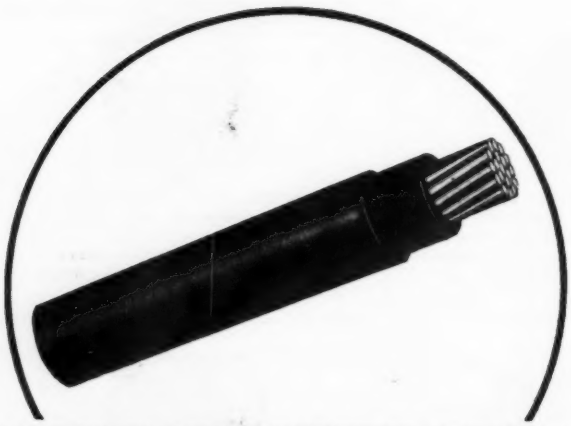

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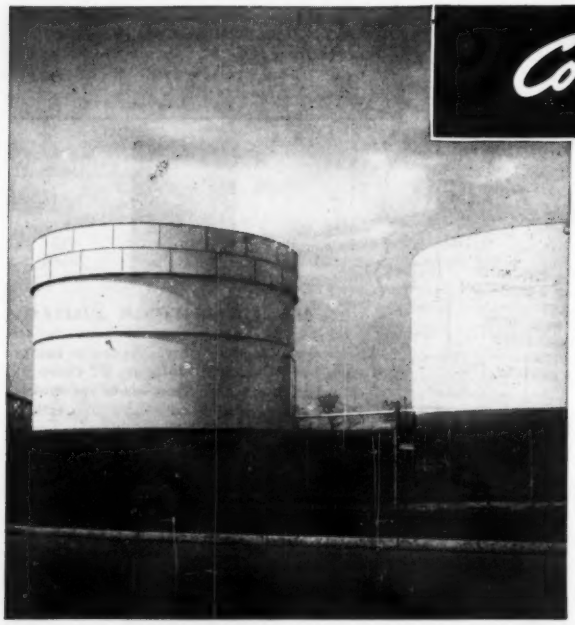
THE SATELLITE ROCKET

(*Continued from page 112*)

still a margin of over 1,000 feet per second. If such an excess occurred in the flight of a rocket, the only effect would be to increase slightly the orbital radius of the satellite rocket.

The over-all performance would be about as shown in the diagram on page 94. The whole three-step rocket would be launched vertically and during the burning period of Step I the rocket would be given only a very slight tilt *to the east,* just enough to prevent Step I from falling on the launching site when it falls to ground. The fuel supply of Step I would be exhausted at an altitude of about 30 miles, a few miles east of take-off point. Step II would be ignited a second or two earlier and lift out of Step I. Step I would continue to rise, but far slower than Step II which is accelerating. It would reach a total altitude of about 120 miles and would strike the ground between 30 and 40 miles east of the take-off point. Step II, in the meantime, would have been tilted to an angle of about 45 degrees during the course of its burning time and Step III would lift out of it just before the fuel supply of Step II is exhausted. Step II would continue on kinetic energy only along a typical long-range trajectory and attain a maximum altitude of about 230 miles. Its impact point would be some 900 miles east of take-off

(*Concluded on page 116*)



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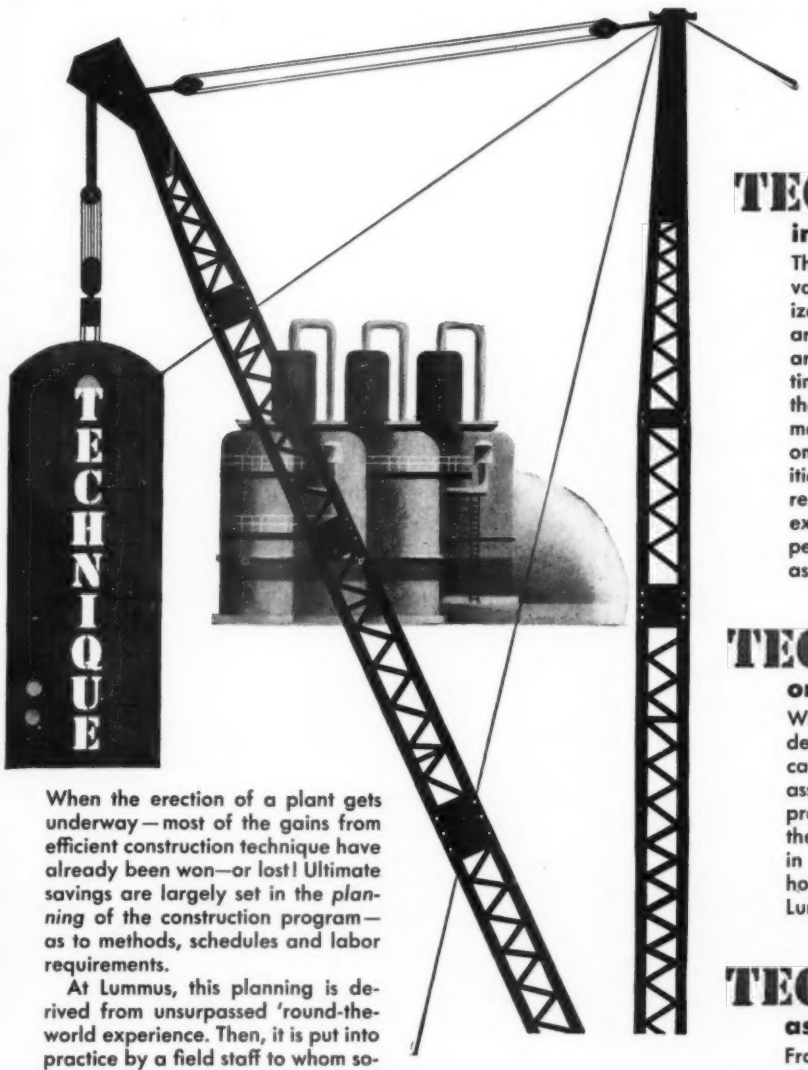

When the erection of a plant gets underway—most of the gains from efficient construction technique have already been won—or lost! Ultimate savings are largely set in the *planning* of the construction program—as to methods, schedules and labor requirements.

At Lummus, this planning is derived from unsurpassed 'round-the-world experience. Then, it is put into practice by a field staff to whom so-called "unpredictables" are old and familiar.

Sound technique, as Lummus applies it, means a sound night's sleep for those we serve who shoulder the responsibility.

TECHNIQUE
in planning

The full effect of detailed planning in advance of actual construction has been realized in foreign work where local facilities are at a minimum. It called for scheduled arrival of tools and materials, periodic estimates of manpower requirements and the preplanning of specific procedures for materials handling and heavy lifts. Economy in requirements for construction facilities, tools and equipment by preplanned re-use at various construction stages is one example. The selection of a staff with experience permitting effective reassignment as the job progresses is another.

TECHNIQUE
on the job

What makes it possible to move a 150-ton derrick intact from one tower-erection location to another, as contrasted to disassembly and reassembly? Planning—plus practical experience of the field staff on the job! Lummus field personnel has served in some 15 foreign fields, as well as at home, and averages better than 10 years' Lummus experience.

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THE SATELLITE ROCKET

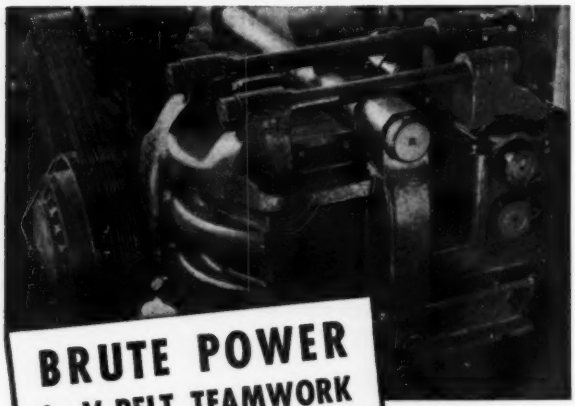
(Concluded from page 114)

point, preferably somewhere in the Atlantic Ocean. Step III would be tilted still more during the course of its burning time until it assumed a horizontal position. Of course it would not return. The total burning time of all three steps would amount to about four minutes.

The question of how large the three-step rocket would have to be depends essentially on the size and mass of Step III which is to be the satellite after exhaustion of its fuel supply. As the art of instrument making has progressed by now, we can safely say that 200 pounds of instruments are an imposing assortment of instruments, all the more so some years from now. If we take this weight as the final pay load and assume that the rocket which houses it will weigh 800 pounds, we get the following table:

Item	*Weight (in pounds)*	*Weight of Steps (in pounds)*
Pay load	200	
Empty hull for Step III	800	
Fuel for Step III (assumed mass ratio of 3.5 to 1)	2,500	
Total weight for Step III (also payload for Step II)		3,500
Hull for Step II	6,500	
Fuel for Step II	25,000	
Total weight for Step II (also payload for Step I)		31,500
Hull for Step I	30,000	
Fuel for Step I	162,500	
Total for Step I		192,500
Total weight of rocket		227,500

Although this figure looks large at first glance, it should be remembered that the Germans planned a transatlantic rocket, the *A-9* + *A-10* project. This was to have a take-off weight of 85 metric tons. It was not actually built, but evidently the designers felt sure that it could be done. A three-step rocket with a take-off weight of 103 metric tons seems to lie within reach of present-day rocket engineering. And the establishment of an orbital rocket is something which certainly is worth some effort.



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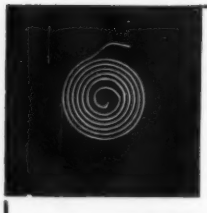

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GOSSIP

(*Continued from page 91*)

Now, a mink coat in itself is a highly desirable evidence of wealth, especially a long, mink coat. Mrs. *A* could not have chosen a more dramatic way to tell everybody that she was rich, in a neighborhood where riches count. She carried out her constitutionals at about 8:00 A.M. while her less fortunate sisters were driving their husbands to catch the morning suburban trains for the big city. These women were no models of style, themselves, for the majority were still completely disheveled, hair unkempt or in curlers, and clothed in dressing gowns (hastily thrown over their bodies), jackets, or coats slipped over pajamas or nightgowns. Of course they were usually unwashed and some of them had even walked their dogs for the few minutes prior to the time that their husbands would emerge with the family cars driven from the rear of their homes. But none had flaunted mink coats or wealth at eight o'clock in the morning! In this instance, all three factors were highly propitious:

I Mrs. *A* flaunted custom and made the women realize how unattractive they themselves looked

A Great antagonism developed toward Mrs. *A* who really had no desire to hurt a soul

S The neighborhood is extremely conscious of itself, its position in society, and is very closely knit, being one of the finest residential sections in the community

A virulent round of gossip permeated the neighborhood, becoming the chief topic of conversation. It reached Mrs. *A* within 10 days when she suddenly appeared for her 8:00 A.M. constitutional the acme of haberdashery perfection. Peace returned and never again has Mrs. *A's* mink coat been mentioned, for she conformed. The neighborhood mistresses continue to look like anemic scrubwomen as they still deposit their lords at the railroad station.

No Sacrifice of Principle

When Mr. and Mrs. *C* moved with their several children to the town of *A*, they settled because they liked the house, the schools, and the beauty of the vicinity. The neighbors seemed adequate and were not an especial consideration. It was not long before representatives of various religious organizations began to extend invitations to the new family to become communicants of one or the other of the churches, clubs, and so on. One and all they left aghast; a heretic was in their midst!

Finally an ultimatum was issued: either Mr. and Mrs. *C* join one of the recognized organizations or no child would be permitted to play with the children of the *C's*! The *C* children had not been brought up to revere the religious precepts inculcated into the facile young minds of the youth of *A*. Such heresy disturbed the very foundations of the forces that tied the people of *A*, one to the other.

The situation had its serious moments when the *C* children found themselves ostracized in the street. Doors were rudely slammed before their faces and friends turned away. For a time, the outlook was indeed precarious, until Mr. *C* resolved the problem

without any drastic revision of principles. He built a small playground behind his own house. It became a mecca for all the youngsters in the vicinity, the parents notwithstanding.

Although the forces of gossip were indeed powerful they were ineffective because *C* neither experienced any solidarity with the ties that bound ($S = 0$) *A*, nor did he reciprocate their feeling of personal insecurity ($A = 0$) although the neighbors obviously felt great antagonism toward the *C* family.

Gossip Triumphs

However, in the case of Mr. and Mrs. *D*, friends of the family *C*, the forces of gossip working in the same way, accomplished their end. Mr. *D*, a highly trained man ran for an elective office. He was defeated because tongues worked overtime against him. He was not a communicant of any church!

Immediately upon his defeat, he and his wife with their children joined a church. Mr. *D* became very active in its secular affairs, while Mrs. *D* contributed her time to endeavors wherein her talents were best suited. The *D* children entered Sunday school and everything became peaceful for *A* and the *D's*.

In this instance, the family *D* succumbed before the gossip since they desired to be part of the community, feeling great insecurity without it. They did not want a feeling of antagonism.

A Case of Gossip Failure

There is no group of men in public service who suffer more from personal insecurity than the members of a police department. They are subject to attack and criticism from their officers and from the public, and especially are they vulnerable to the machinations of politicians. As a group they have the solidarity of the uniform, but they experience great antagonism toward anyone of whom they might be suspicious of carrying tales. In a sense, theirs is an unenviable lot.

World War II made many of the patrolmen, who were not accepted under the Selective Service Act, unhappy and nervous men, for their meager forces were augmented by civilian wardens, auxiliary policemen, and so on. The regular policemen hated them, not only because they feared for their own jobs, but also because of the stories they dreaded the civilian police might carry back.

G was one auxiliary policeman who became the brunt of much antagonism because he was conscientious. Gossip had him writing letters to the chief, bearing fancied stories, reporting men who were derelict in their duties. The regular patrolmen were insulting during their frequent contacts with him, and, in general, tried to make their relationships as humanly unpleasant as possible.

The policemen were frightened, although as events in later years proved to their satisfaction, completely without justification or foundation. Albeit they were jealous and suspicious of each other, the policemen still recognized themselves as a distinct group with a peculiar and strained sort of feeling of deep solidarity. The antagonism toward *G* was extremely intense.

(*Continued on page 120*)

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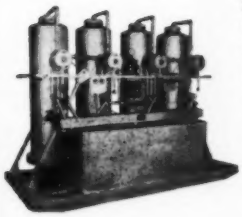

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GOSSIP

(*Continued from page 119*)

So far as *G* was concerned, since his conscience was clear and he understood the inner forces that motivated the sentiments of resentment against him, the attacks amused rather than disturbed him. Much to the chagrin of many in the department, *G* neither diminished his intense interest in police work, nor severed his connections with the department so long as the war emergency lasted. He may have believed, as did many another patriotic citizen, that a period of crisis is hardly the time to leave a post of responsibility, even though continuance may be unpleasant.

In this instance, the forces of gossip failed to be efficacious because, notwithstanding *G's* desire to be part of the police group, he suffered naught from their antagonism. Since *G* was a civilian, he could not be too seriously affected by any sense of personal insecurity through any antagonism displayed against him. It should be mentioned that had *G* been employed in any other branch of the city's administration, his independence could not have been maintained upon so high a level. Instructions would have gone down the line, passing the stage of gossip to the more active form of social control, command. Since, in fact, *G* was gainfully employed outside the community of *X*, there was little else that could be marshaled against him other than gossip. It failed its point.

Parental Pride

Consider now the case of the family of Mr. and Mrs. *I*. All parents love and admire their children, and enjoy recounting their exploits and accomplishments. However, Mr. and Mrs. *I* indulge in this pastime to the virtual monopoly of all other intellectual pursuits. In the presence of the *I's* all conversation ceases, for it becomes necessary to listen as they expound upon the virtues, brilliance, pulchritude, and erudition of their offspring.

It is not that the *I's* are dull people – far from it. In fact, in their own right they are bright, capable, and gifted. But, listening to them extol the virtues of their children, always with invidious comparison, gives their audience a terrible sense of inferiority and insecurity. So often, friends leaving the presence of the *I's* will say, "What have we got in comparison?"

The *I's* are rarely invited to visit their neighbors. Apparently, the gossip has not reached them as yet. Someday it will.

(*Continued on page 122*)

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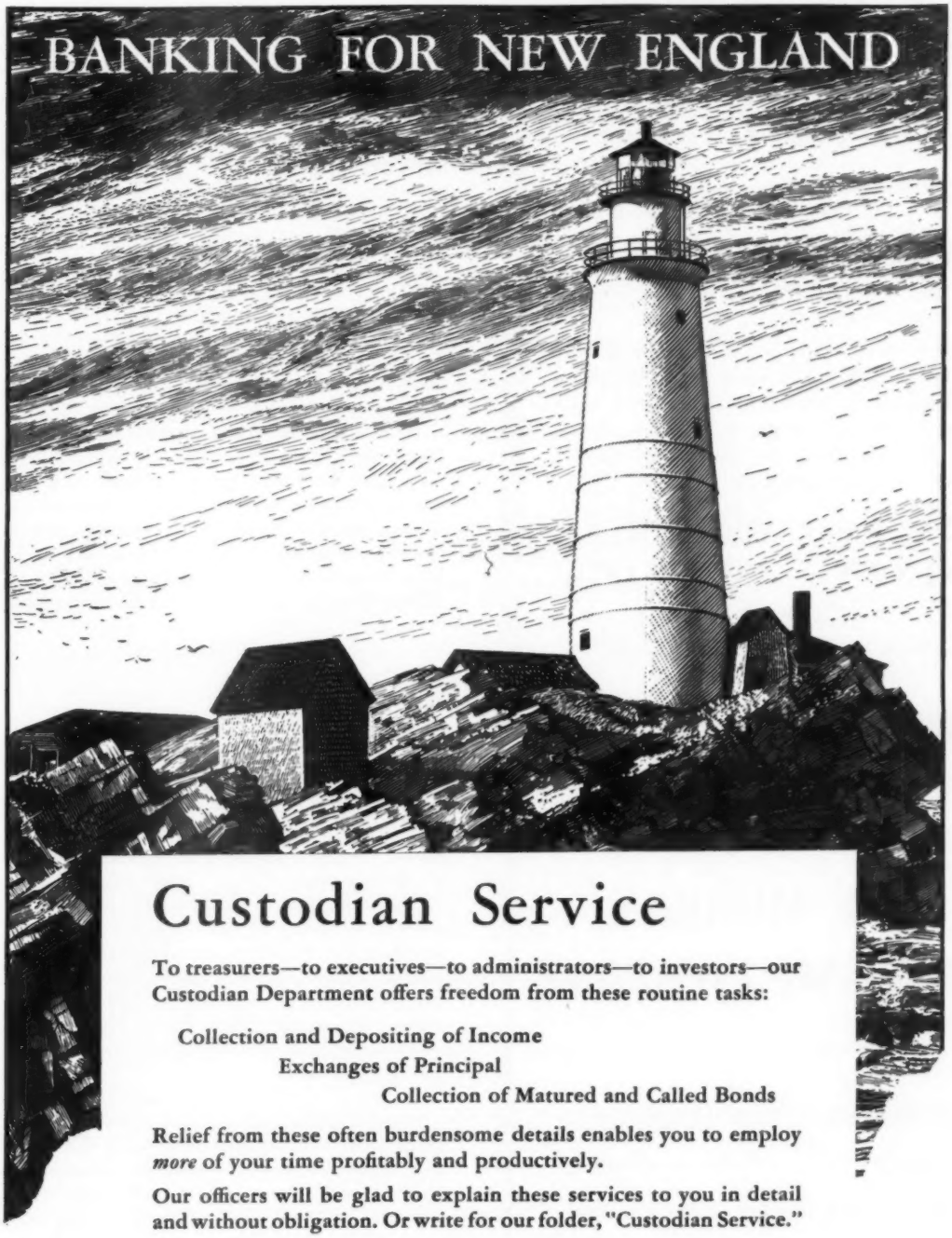

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GOSSIP

(*Continued from page 120*)

Gossip Can Be a Terrible Thing

J is active in politics and civic affairs in the city of *X*, and therefore has to be extremely careful of his reputation. In a small community a whisper of irregularity is sufficient to destroy a man's political life. Some time ago *J* participated in an automobile accident. Facetiously, one of his friends remarked in the presence of others, that he wondered whether *J* was sober when the accident occurred. Immediately, like a fighting cock, *J* flared up to defend his reputation. Then he took his friend aside and begged him never to say anything like that again, even in jest. As he expressed it, "Gossip can be a terrible thing." *J* dreaded the potential force of gossip that might have started.

These examples are, by no means, the only ones which could be cited to illustrate the manner in which gossip works its ways in our daily living. Nevertheless, they have been selected to indicate the manner in which gossip depends upon the interdependent relations of personal insecurity, antagonism, and solidarity as given in the equation in this article; they have also been selected to show how these factors have influenced personal behavior in certain instances.

*International Audience**

For the most part, the type of gossip with which this article has dealt has been of the type which is conducted on a local scale, and its effectiveness has been dependent upon more or less personal contact between the dissenter and the gossiper. But we may note another kind of gossip, which has reached much larger geographical extent in recent years, and in which the personal contact between protagonist and dissenter is extended to a vast audience through the technical facilities which modern journalism and communication place at our disposal. This is the sly innuendo, the facetious remark, and particularly the partial, misleading, and incomplete truths uttered at interviews, press conferences, and investigations of one kind or another. Here the purpose of contact with news-dispensing agencies is obviously to exercise social control.

In earlier generations, incomplete, inferential, and erroneous or deceptive statements could, perhaps, be passed off without attracting more than local attention. But with the widespread rise of news broadcasts, the interpretation of news by radio commentators, the editorial comment by columnists who often have strong personal feelings, and the universal employment of newspaper headlines, frequently of the "scare" type, such gossipy scraps of incomplete information or misinformation receive widespread circulation and create an impact on the mass mind which is usually all out of proportion to their intrinsic significance. They are not thoroughly analyzed, except possibly in the small print which, if read, follows the headlines which have already created a preconceived notion.

(*Continued on page 124*)

* The remaining portion of this article, included as the editor's comment on a problem of current importance, is appended to Mr. Joffe's article with the permission of the author. — Ed.

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GOSSIP

(*Continued from page 122*)

This phase of gossip is national, or even international, in scope and is employed with great effectiveness against public servants or leaders in industrial, educational, or religious affairs. It is employed by those who feel themselves insecure and who are antagonistic toward the dissenter, and by those who desire to increase their solidarity within the group. It has even been employed by those whose primary aim has been to direct attention to themselves without regard to the rights of others. In any case, the motives are the same as those underlying the gossip going on in the local drugstore or the corner beauty shop.

The effects of such nation-wide gossip are far more serious and damaging to our welfare than when conducted on a neighborhood scale, however. Frequently, as in the case of comments made by investigating bodies, remarks once broadcast tend to take on the attributes of character assassination, and those attacked have no adequate means of defense or rebuttal. Even when such opportunity is generously provided, a certain amount of "social control," which can never be completely undone, no matter what the merits of the case may be, has been achieved. The harm is greatest in those increasingly numerous cases in which there may be perfectly just and honest differences of opinion on matters of such a technical nature that the layman is in no position to judge the merits of the facts on the two sides of the question at issue.

The seriousness and viciousness of such nation-wide gossip becomes readily apparent when it is realized that it serves as a strong deterrent for many qualified persons to accept positions of public service where their training and experience might be invaluable. President Truman, and others in public life, have directed attention to the difficulty of obtaining eminent men for public service. Many of those who enter public service make very real sacrifices in giving up their private business practices, and it would not be difficult to compile a long list of those who return to their private affairs at the earliest opportunity. The position of such public benefactors is an understandable one, however. So long as the Constitution guarantees the right to the pursuit of happiness, it would be strange indeed were we to expect eminent persons to volunteer enthusiastically for positions in which they may be, at any time, subject to the insidious maltreatment of gossip.

(*Concluded on page 126*)

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GOSSIP

(*Concluded from page 124*)

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Get a Close-Up OF THE BASIC INDUSTRY OF YOUR CHOICE!

by R. S. FLESHIEM
Manager Electrical Department
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(Graduate Training Course—1904)

WHEN YOU GET into daily working contact with an industry, you may find it offers specialized opportunites that you hadn't known about before. That's why it's not always possible—or wise—to pick *your* final spot in industry until you've had some all around first-hand experience.

R. S. FLESHIEM

I want to suggest a good way to *get* a close-up of the industries that appeal to you.

Naturally, I can talk with most assurance about the electric power industry. But the same principles apply to others.

When I got my engineering degree from the University of Michigan, the electric power industry was a fast-growing youngster. I decided to go to Allis-Chalmers, where I joined the company's first Graduate Training Course in 1904. I was sent to Cincinnati and started in the old Bullock Electric Mfg. Co. plant that Allis-Chalmers had purchased that same year. Bullock, incidentally, started in 1884—one of the real old-timers in the electric industry. It was the start of the present Allis-Chalmers Electrical Department.

Opportunities Are Increasing

The industry was growing fast at the turn of the century, but it's growing even faster now. Opportunities were never greater—or more varied.

Studying power and capacity factors in ore crushing, in Allis-Chalmers' complete basic industries laboratory. Camera-recorded data will be applied to commercial mining operations.

Inside View of a hydrogen-cooled steam-turbine generator. A-C Graduate Training Course students may follow important electric power equipment from blueprint to installation.

Today we have Graduate Training Course engineers applying their ability and training to the problems of machine design—research and development—manufacturing and production—sales—application engineering. Here we're working with electric power generation, control and utilization—with advanced industrial uses of electronics—with research in D. C. transmission. We're in intimate touch with the electric power industries—with transportation—with steel, metal working and other big power users. And I know that the field is just as broad in the other major industry departments here at Allis-Chalmers.

What Industry Interests You?

I firmly believe that Graduate Training Course engineers have a unique opportunity at Allis-Chalmers. They have the opportunity here to explore thoroughly not one, but many basic industries if they choose. This company produces the world's widest range of major industrial equipment, and every department is open to the graduate engineer. That includes electric power, mining and ore reduction, cement making, public works, steam turbines, pulp and wood processing. It also includes the full range of activities within each industry: design, manufacturing, sales, research, application, advertising.

Graduate students help plan their own courses at Allis-Chalmers, and they move around a good deal. It's possible for a man to come here with the idea of designing electrical equipment—later become interested in manufacturing—and finally find his greatest satisfaction and success in sales work. Men move from department to department, getting a practical working knowledge of each. And—the departments get to know the men. Opportunities present themselves according to ability.

At the completion of the Graduate Training Course, you've had a close-up of many industries. You're ready to take your place in the work of your choice.

Write for details of the Allis-Chalmers Graduate Training Course—requirements, salary, advantages.

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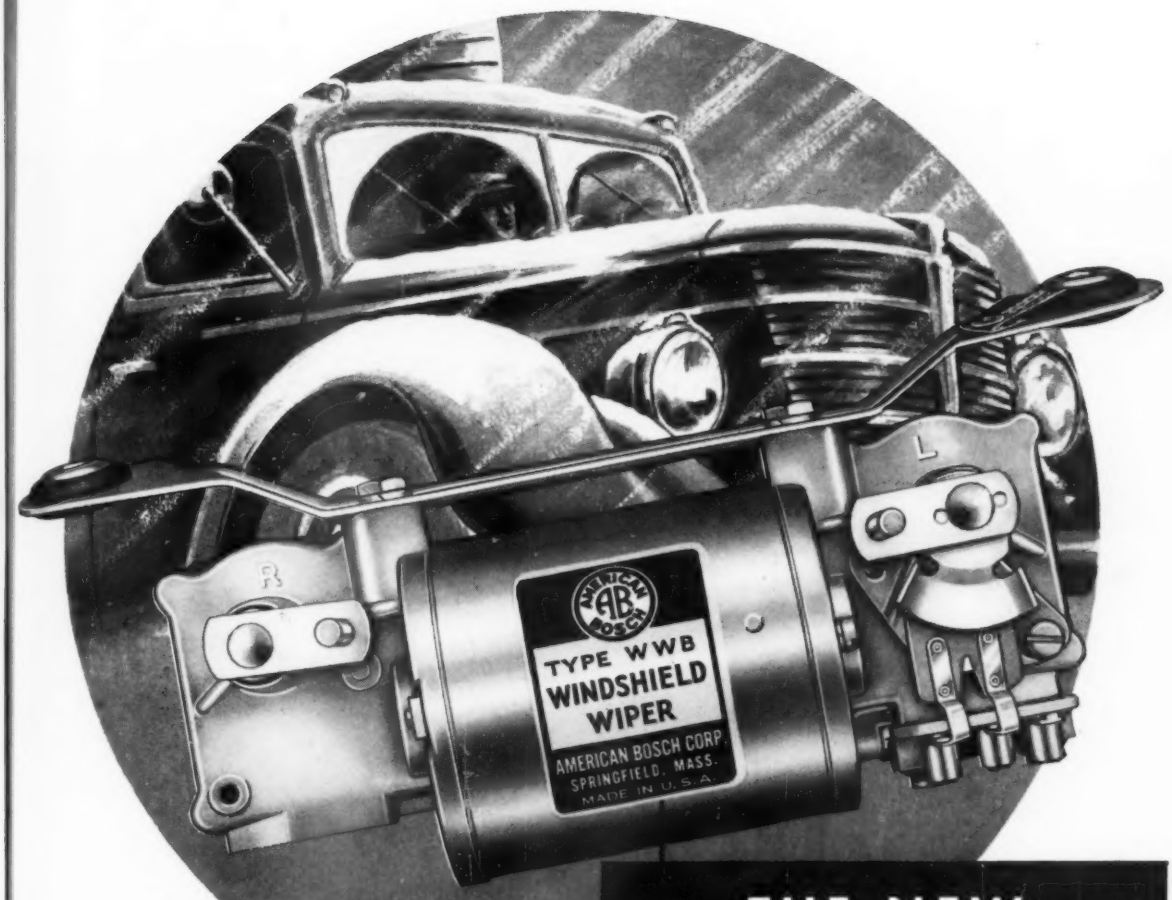

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- **ADVANCED BRUSH CONSTRUCTION** — coil spring maintains uniform brush pressure under all conditions of brush wear; very low inertia of sprung weight in moving part results in less wear under vibration, and eliminates bounce; NO TOOLS needed to change brushes
- **READILY REMOVABLE SHAFT** — for reversing to table or panel mounting — requires no disassembly of radiators, collars, etc.
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- **NO PIGTAIL CONNECTIONS**
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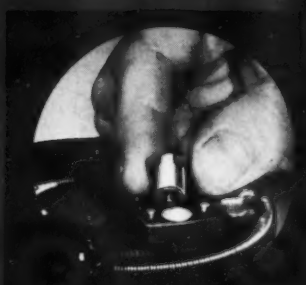
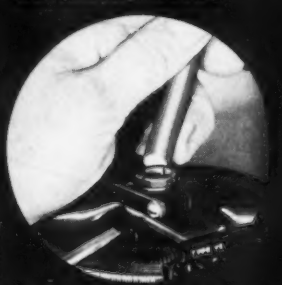


NO tools needed to change the VARIAC brush. A twist of the cartridge-like holder and it and the brush come out immediately.



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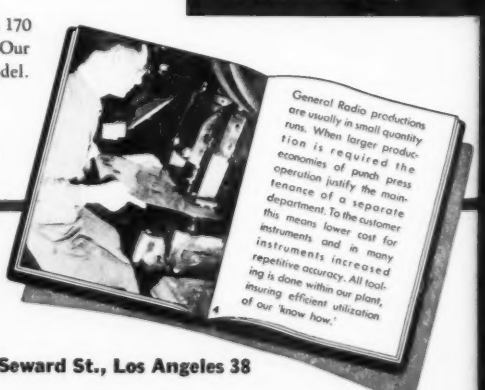
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